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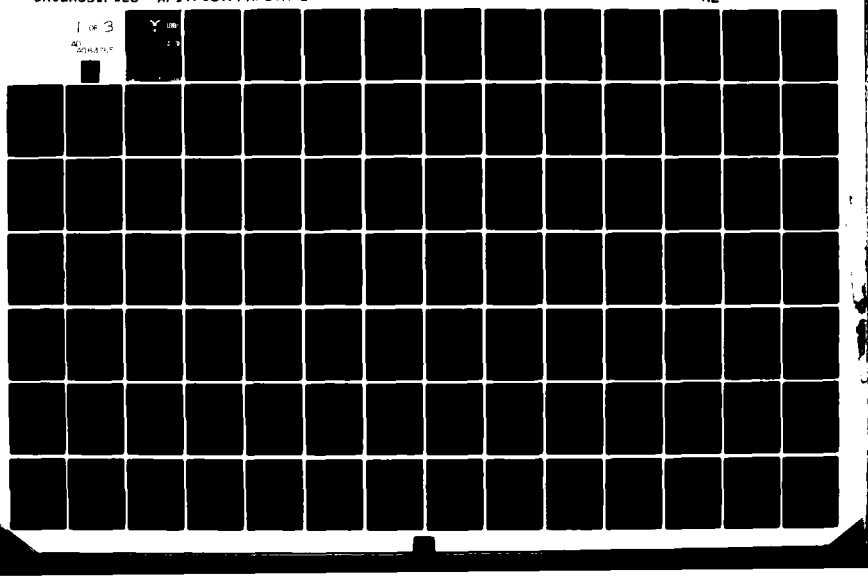

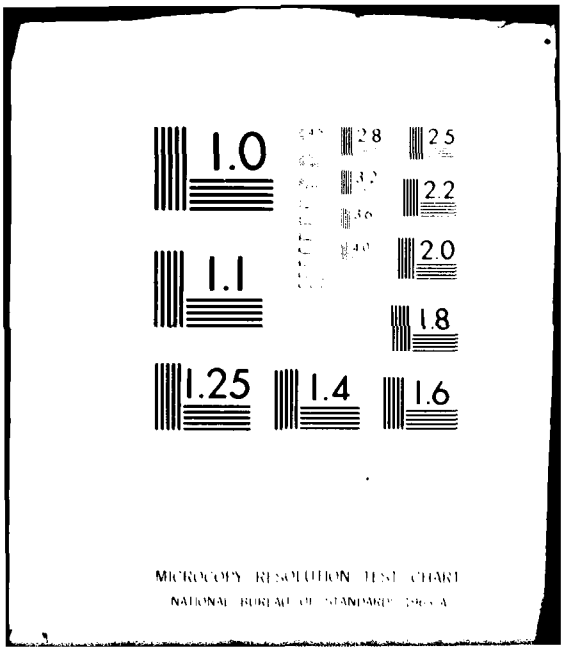
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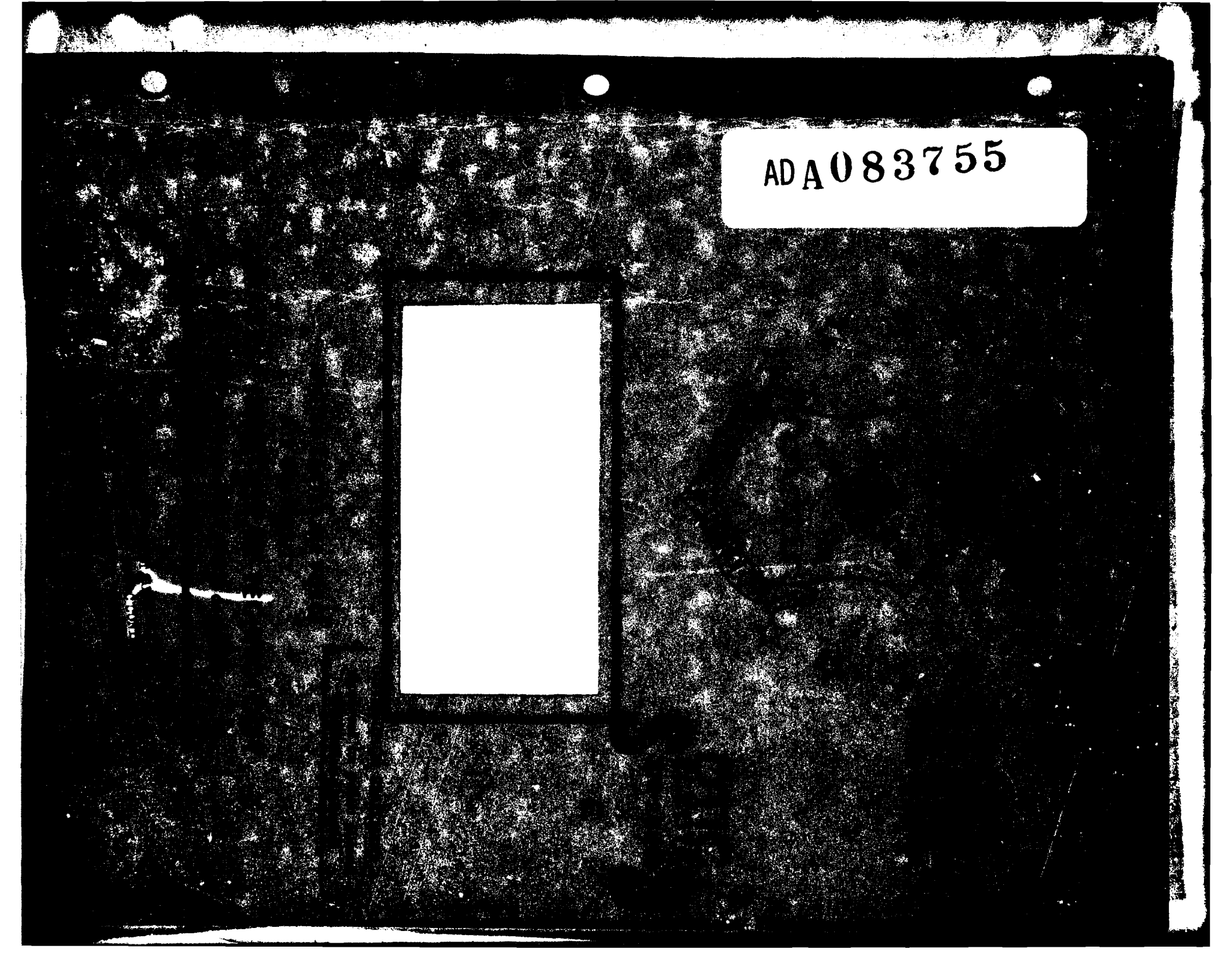

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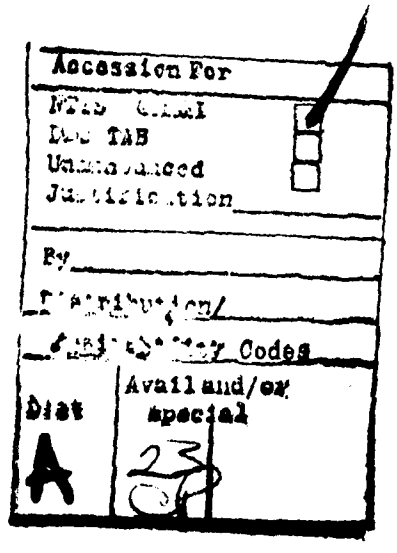

(6) A COMPUTER FALLOUT MODEL FOR OPERATIONAL TYPE STUDIES.

(9) Master's THESIS

(10) Richard F. Colarco

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A COMPUTER FALLOUT MODEL FOR OPERATIONAL TYPE STUDIES

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Operations Research

by

Richard F. Colarco, B.S.

Capt USAF

March 1980

Preface

The study of radioactive fallout for nuclear explosions assumes great importance in an era when our country's defense is heavily invested in land-based ICBM systems. An attack on the ICBM force could possibly consist of several thousand nuclear weapons of fairly large yield (megaton range) detonated on or near the ground. Such an attack could have consequences to the civilian population more far-reaching and less immediately apparent than most military planners consider. In fact these consequences should be considered in planning for any future weapon systems. The hardest ICBM system imagineable would be worthless, except as a spasmodic revenge weapon, if an attack on it would collaterally destroy the very people it was in place to protect.

I present here a method of studying the grosser manifestations of nuclear fallout, a method that should enable a planner to easily "scope the problem" for a single weapon detonation.

Thanks are due to Maj. Scott Bigelow of the Air Force Weapons Laboratory for his help in the collection of background material for this work, and also for his support in running the DELFIC program for validation of some of the results presented here. I am particularly indebted to Dr. Charles J. Bridgman for guiding this work from beginning to end, and to my wife, Linda, for her patience and her typing.

Richard F. Colarco

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Abstract

This study describes a method of calculating g(t), the rate of deposition on the ground of radioactivity from the stabilized cloud resulting from a nuclear ground burst. Particle fall dynamics are described by the method of Davies as formalized into a computational algorithm by McDonald. The radius of particle arriving on the ground at any time from a given altitude, and the rate of change of this radius with time are described by polynomials in 1/t. A table of coefficients of these polynomials from 200 meters to 50 km above sea level is provided. It was found that a pancake (zero-thickness) cloud is an excellent approximation to a vertically-distributed cloud with finite extent. This, and the closed form of the calculation, make for a relatively simple and straightforward algorithm, one in fact that approaches the ease of a hand calculation.

I Introduction

When a nuclear weapon is detonated on or near the earth, a large amount of debris is thrown up into the air. For a given weapon, the weight of debris is of the order of the weapon yield. For example, the detonation of a 100-kiloton weapon will result in a cloud of debris totalling approximately 10^5 tons in weight.

A large proportion of the radioactive products of the explosion condense into and onto particles with radii in the micron (10^{-6} meter) range. These particles will fall to earth anywhere from mintues to years after the explosion. These particles are fallout.

In the following sections and chapters, a method will be developed to study the rate at which this fallout reaches the earth from the nuclear cloud, and to estimate radioactive doses from the fallout. At all times a surface nuclear burst will be assumed. Fallout from the cloud stem will not be considered, as this is a concern only near the detonation point where other damage effects predominate.

The form of the fallout calculation will be a departure from the method of WSEG-RM-10 (Ref 1), hereafter referred to as "WSEG". WSEG introduced the concept of the g(t) function, and combined this with methods of fallout cloud description and radioactive dose calculation. The result was a fallout model that has been widely used up to the present day.

WSEG's g(t) is empirical and does not stand up to

close scrutiny. The g(t) presented in this work is derived from a consideration of particle aerodynamics and thus provides a more physically satisfying approach to fallout description without discarding the essential simplicity of the WSEG method.

General Form of g(t)

"For any radioactive cloud configuration there exists some function of time, g(t), that represents the fraction of the total radioactivity that arrives on the ground per unit time". (Ref 1:4) This rate of arrival includes all radioactivity arriving over the entire ground surface.

Consider a radioactive cloud of zero thickness at an altitude z' above the ground. Let the radioactivity in this cloud be distributed over the variously-sized particles as a normalized probability density function of a random variable representing "activity-size". Denote this pdf as A(r). Since activity is not distributed uniformly over particle size, A(r) will not be identical to the particle (number)-size distribution in the cloud. The form of A(r) is generally taken to be log-normal. (Ref 2:10)

Assume that we can derive an expression for the fall time t for a particle of radius r from altitude z':

$$t = f(r,z') \qquad (1)$$

Solving for r and differentiating, we would get the rate of change of particle size landing on the ground at time t

from altitude z':

$$\left|\frac{dr}{dt}\right| = F(t,z') \qquad (2)$$

For a pancake (zero-thickness) cloud

$$g(t) = A(r)F(t,z') \qquad (3)$$

For a real (vertically-distributed) cloud with normalized vertical distribution function $f_z(z')$

$$g(t) = \int_{z_B}^{z_T} f_z(z')A(r)F(t,z')dz' \qquad (4)$$

where z_B is the altitude of the bottom of the effective cloud and z_T is the altitude of the top.

It should be noted that, from a given altitude z', there is only one size of particle that can hit the ground at time t. Thus A(r) is a function of (t,z'). The cloud vertical distribution, $f_z(z')$, is here assumed to be Gaussian, with the mean cloud height a function of yield and the cloud height standard deviation a function of mean cloud height. (Ref 1:11,51).

Chapter II will detail the calculation of the function F(t,z'). Chapter III will combine all relevant quantities into the calculation of g(t) and will discuss the pancake cloud approximation. Chapter IV will discuss the calculation of radiation dose quantities. Chapter V will present

a number of fallout calculations.

II Calculation of Particle Fall Quantities

For the eventual calculation of g(t), we require a method of determining the size and time rate of change of size of particles arriving on the ground from a particular altitude. (F(t,z') in eqn.(2)). Particles are assumed to be spherical, and to have a density of 2600 kg/m^3.

Stokes' Law for Small Particles

Stokes' law, which applies to particles of sizes up to about 10 microns, relates fall velocity to particle radius as:

$$6\pi\mu vr = (\tfrac{4}{3}\pi r^3)\rho_s \rho_a g \qquad (5)$$

where:

μ = dynamic viscosity of fluid medium (kg/m-sec)

v = fall velocity of particle (m/sec)

r = radius of particle (m)

ρ_s = density of particle (kg/m^3)

ρ_a = density of fluid medium (kg/m^3)

g = gravitational constant (nt-m^2/kg^2)

Note that μ and ρ_a are functions of altitude where the fluid medium is the atmosphere. Hence v is a function of altitude. The variation of g with altitude will be ignored

Rearranging and integrating (5) from the particle's starting altitude to the ground gives

$$\frac{9}{2\rho_s g}\int_0^z \frac{\mu(z')}{\rho_a(z')}\,dz' = r^2\int_0^t dt' = r^2 t \qquad (6)$$

where z is the starting altitude of the particle and t is the time to fall from z to the ground. All calculations will assume ground is at sea level. Holding z constant and taking the total differential of (6) gives

$$0 = 2rtdr + r^2 dt \qquad (7)$$

Rearranging (7) gives

$$\frac{dr}{dt} = \frac{-r}{2t} \qquad (8)$$

the absolute value of which is F(t,z). The solution to the differential equation (8) is

$$r = Ct^{-1/2} \qquad (9)$$

An expression of this general form will hold for particles in the Stokes' law regime.

Mc Donald's Algorithm

For calculation of particle fall rates over the range of particles of interest ($5\mu m \leq r \leq 1525\mu m$) the method of Davies (Ref 3) as presented by McDonald (Ref 4) will be used.

Forty particle radii in the range of 5 microns to 1525 microns were chosen. The range and spacing of these radii

were selected through examination of several available activity size distributions (Ref 5:21) and consideration of the operation of the least-squares fit subprogram employed in the generation of polynomials to describe particle fall. Figure 1 is a plot of some representative activity size distributions.

For each particle radius, a time to fall through each 200 meter altitude increment from sea level to 50 km was calculated by the method described below. This assumed that a particle achieves its terminal velocity essentially immediately upon beginning its descent, and that its velocity does not change within a particular 200 meter block. The times obtained were numerically integrated to obtain a time of fall for each particle size from each multiple of 200 meters to sea level. A function of the form

$$r(t,z) = \sum_{i=1}^{6} C_i(z)t^{i-6} + C_7(z)t^{-\frac{1}{2}} \qquad (10)$$

was assumed, with r(t,z) being the radius of the particles hitting the ground at time t from altitude z. The $t^{-\frac{1}{2}}$ term insures agreement with Stokes' law at small r (large t). Differentiating (10)

$$\frac{dr}{dt} = \sum_{i=1}^{5} (i-6)C_i(z)t^{i-7} - \tfrac{1}{2}C_7(z)t^{-3/2} \qquad (11)$$

The actual calculation of the polynomial coefficients will be described. (Note: in the following development, the

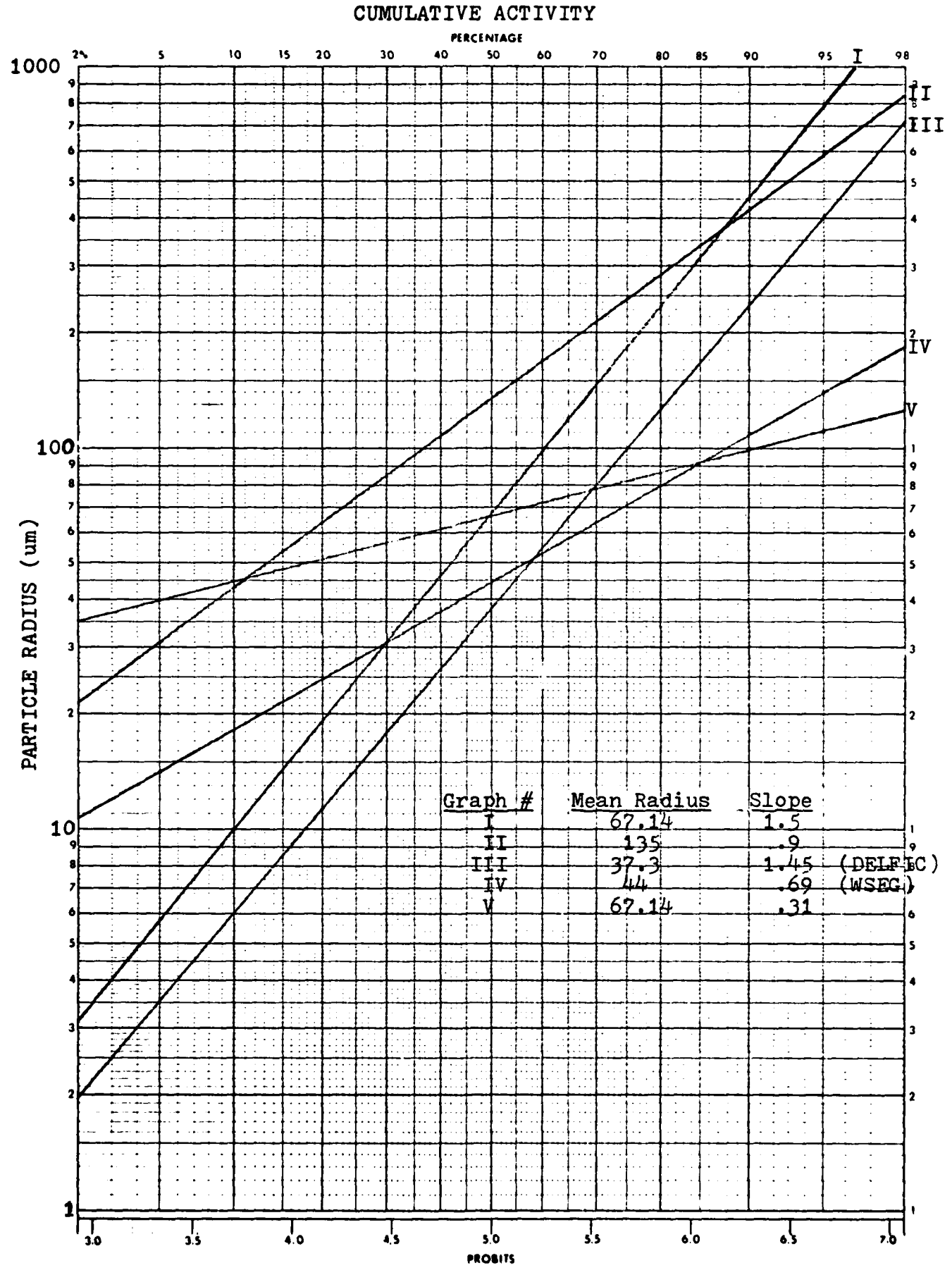


Fig 1. Activity-Size Distributions

quantity μ, the dynamic viscosity of air, is used instead of η, the kinematic viscosity, which McDonald uses. This was done out of convenience since a table of atmospheric densities (ρ_a) and μ was available on cards. Bear in mind that $\eta = \mu/\rho_a$)

After determining the required atmospheric data, a quantity Q was calculated for each 200 meter altitude block by the relation

$$Q = 8W\rho_a/\pi\mu^2 \tag{12}$$

where

$$W = \frac{4}{3}\pi r^3 \rho_s g \tag{13}$$

is the weight of the particle. Combining all the constants and using $\rho_s = 2600$ kg/m^3 we have

$$Q = 272064.\rho_a r^3/\mu^2 \tag{14}$$

We next calculate Reynolds number by the method given by DELFIC (Ref 6:6):

$$Re = Q/24 - 2.3363\text{x}10^{-4}Q^2 + 2.0154\text{x}10^{-6}Q^3 - 6.9105\text{x}10^{-9}Q^4 \qquad \text{(for } Q < 120\text{)} \tag{15}$$

or

$$\log_{10}Re = -1.29536 + .986\log_{10}Q - .046677(\log_{10}Q)^2 + .0011235(\log_{10}Q)^3 \quad (\text{for } Q \geq 120) \tag{16}$$

Velocity is then given by

$$v = Re\mu/2r\rho_a \tag{17}$$

DELFIC (Ref 6:6) suggests that these velocities should be multiplied by a drag slip correction factor (from Davies (Ref 3)) which, when converted to the units used here, is given by

$$\text{drag slip correction} = 1 + 1.165\times10^{-7}/r\rho_a \tag{18}$$

To arrive at times of fall, we numerically integrate

$$t = \int_0^z \frac{dz'}{v(z')} \tag{19}$$

using the velocities calculated in (17).

The coefficient of the Stokes' law term in the radius polynomial is calculated by noting that the smallest (r = 5 microns) particle must obey Stokes' law explicitly. Thus

$$C_7 = r^* \sqrt{t^*} \tag{20}$$

where r^* = 5 microns and t^* is the time of fall calculated

in (19) from a given altitude for r = 5 microns. We then rearrange the radius polynomial (10) to get:

$$r = C_7 t^{-\frac{1}{2}} = \sum_{i=1}^{6} C_i t^{i-6} \qquad (21)$$

Repeating the process for each altitude, we calculate corresponding r and t values. A least-square fit is carried out on (21) and the resulting coefficients, along with C_7, are those we desire for our r vs. t polynomials.

Appendix A contains a listing of the CGEN code used to generate the coefficients, a table of the resulting C values, and plots of particle radius on the ground vs. time for several altitudes.

III Calculation of g(t)

Having developed a method in Chapter II for predicting the radius of particles arriving on the ground from a certain altitude as a function of time, and the rate of change of this radius, we can proceed to the calculation of g(t). We assume a log-normal activity-size distribution A(r):

$$A(r) = \frac{1}{\sqrt{2\pi}\beta r} \exp\left(-\tfrac{1}{2}\left(\frac{\ln r - \ln \alpha}{\beta}\right)^2\right) \qquad (22)$$

where α and β are parameters of the distribution and have been experimentally determined by a number of examiners. Table 1 lists several sets of these parameters and their sources.

Cloud Parameters

The vertical distribution f(z) of particle size in the cloud is assumed to be normal, centered on the cloud center height with some specified standard deviation. We will use the following relations for the cloud parameters (Ref 7:18):

$$h_0 = 50.7 + 20.4\log_{10}Y + 3.5(\log_{10}Y)^2 + 2.4(\log_{10}Y)^3 + .6(\log_{10}Y)^4 \qquad (23)$$

$$\sigma_h = .125h_0 \qquad (24)$$

TABLE I

Activity-Size Distributions

Mean Particle Radius (um) - α	Standard Deviation β	Comment
56.5	1.69	Nevada soil
67.14	1.50	Nevada soil
67.14	.31	Nevada soil
81.	.98	Coral
61.	.41	Seawater
42.8	.39	Seawater
40.8	.8	Cap of cloud
75.	.9	Cap of cloud
135.21	.9	Cap of cloud
44.6	.69	WSEG-RM-10 95% of cloud act.

Notes:

- Information taken from Russell (Ref 5:21), which contains primary sources for the data.
- Values are the parameters of A(r) as shown in (22).
- These numbers are representative and are meant to demonstrate the possible ranges over which A(r) can be calculated for various conditions.

where

h_0 is the cloud center height in thousands of feet

Y is the weapon yield in megatons

σ_h is the standard deviation of the cloud vertical (normal) distribution

Pancake Approximation

We now have all of the ingredients we need for a g(t) calculation, and could proceed to a direct (numerical) integration of equation (4). This in fact was done in the early stages of investigation. However, it was later found that approximating the vertically-distributed cloud by a pancake (zero-thickness) cloud at the calculated h_0 gives results very close to those of the numerical integration. In this case g(t) is given by

$$g(t) = A(r)\left|\frac{dr}{dt}\right| \qquad (25)$$

which is equivalent to equation (4) if the assumption is made that all activity is concentrated at one particular altitude.

One representative comparison of g(t) results from a vertically distributed cloud and a pancake cloud is shown here as figure 2. Several more comparative plots are presented in Appendix C.

Pancake g(t) results are used in all further calculations in this work. A base case was chosen to serve as a starting point for examination of the effects of varying

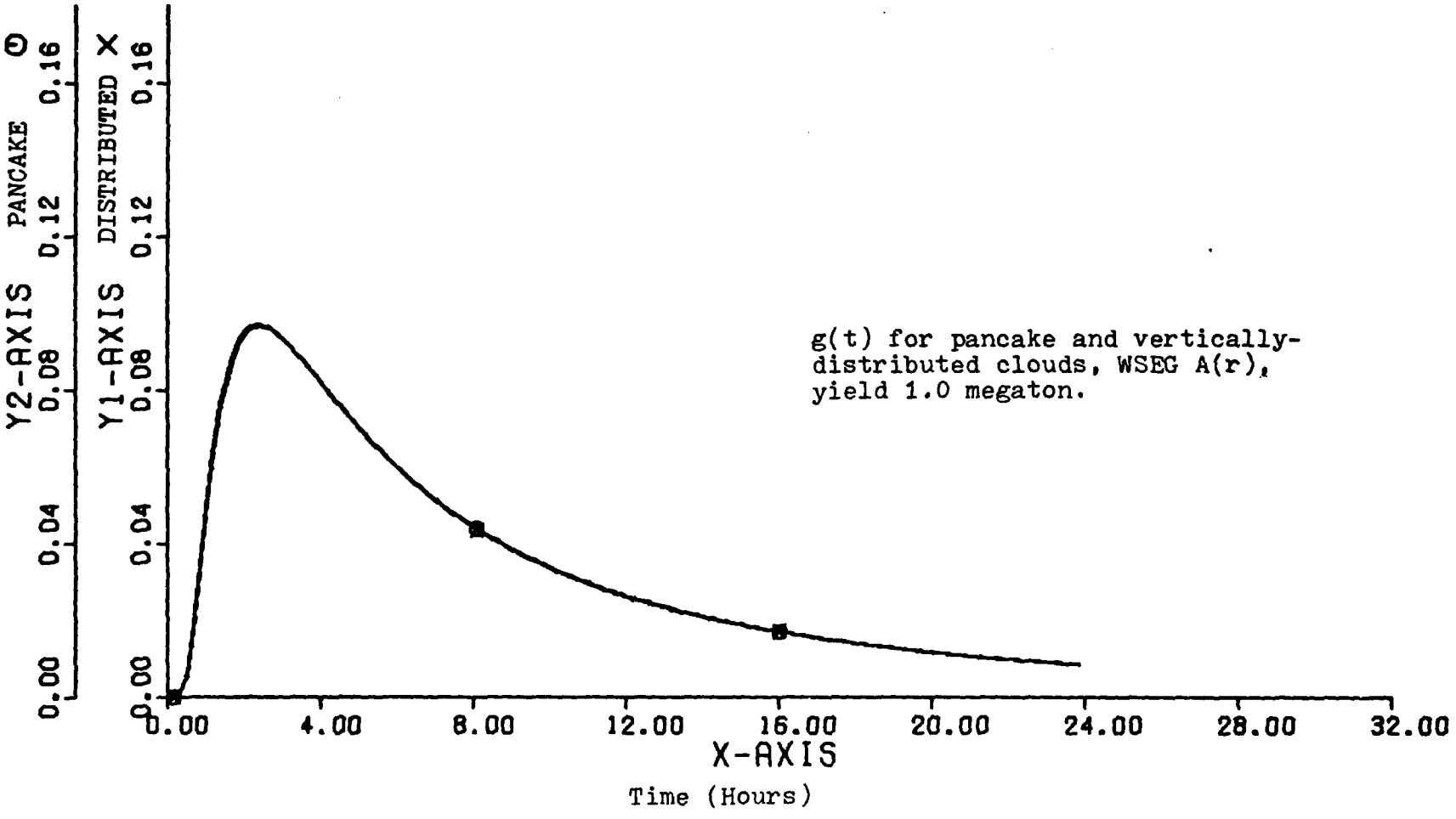


Fig. 2

g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield 1.0 megaton.

the parameters of the fallout problem. The parameters used in the base case are as follows:

- weapon yield variable from 1 KT to 200 MT
- final time for calculations of twenty-four hours
- activity-size distribution as specified in Ref 1.

Several other parameters become of interest in dose calculations. These will be discussed in Chapter IV.

Appendix B contains a listing of the FALL code used in calculating g(t) and dose-related quantities. Appendix B also contains a brief discussion of the operation of the program and a user's guide to running the program.

Comparison of a g(t) calculation made as described above with a DELFIC run is made in Appendix D.

IV Dose Rates And Accumulated Doses

After consideration of several schemes for presenting radiation dose information, the author has settled on the following: unit-time reference dose (UTRD) rates and accumulated exposure doses to $t=\infty$ are calculated for a steady effective fallout wind and constant wind shear. This allows comparison with several other fallout prediction systems and offers some measure of lethality for planning purposes.

The function g(t) describes the rate of fallout activity deposition over the entire ground surface. To translate g(t) into dose calculations, we must first expand the problem by defining a geometry.

We will assume that the radioactive cloud is borne along in the positive-x direction by a wind of constant effective velocity. The horizontal size of the cloud will increase from some initial value due to wind shear effects in the cloud. We will assume that this expansion is predominantly in the y (crosswind) direction, and ignore the x-component of wind shear. The horizontal distribution of activity in the cloud will be assumed to be normal in both the x and y directions.

Cloud Growth

The following development is from WSEG-RM-10 (Ref 1). The initial cloud diameter can be described in terms of a cloud radius parameter, σ_0, given by (Ref 7:21)

$$\sigma_0 = (.9 - .4\log_{10}Y + .3(\log_{10}Y)^2 + .1(\log_{10}Y)^3) \exp$$
$$(.7 + \tfrac{1}{3} \ln Y - 3.25/(4+(\ln Y+5.4)^2)) \qquad (26)$$

where σ_0 is in statute miles. In actual calculations we convert to the MKS system. An intermediate time parameter T is calculated by

$$T = h_0/1524 - 2.5(h_0/18288)^2 \qquad (27)$$

with h_0 in meters. We define $L_0 = vT$ where v is the effective fallout wind in KM/HR. Then, if $L_0^2 \gg 2\sigma_0^2$ (a fairly easy requirement to satisfy, see Table II), we can express the cloud radius parameter in the y direction as a function of x as

$$\sigma_y^2 = \sigma_0^2(1 + \tfrac{8x}{L}) + (\tfrac{x}{v}s_y\sigma_h)^2 \qquad (28)$$

where s_y is the crosswind component of shear and

$$L = (L_0^2 + 2\sigma_0^2)^{\frac{1}{2}} \qquad (29)$$

assuming that the wind shear in the cloud has no downwind component. It should be noted that $t = x/v_x$, so equation (28) is equivalent to a second order polynomial in t.

Calculation of Unit-Time Reference Dose Rates

Since we have assumed a constant effective wind, each time for which a g(t) value is calculated can easily be

TABLE II

RELATIONSHIP OF L_0^2 AND σ_0^2 , WIND VELOCITY OF 25 KM/HR

YIELD, MT	h_0, METERS	T, HOURS	σ_0, KM	L_0, KM	$L_0^2/2\sigma_0^2$
.001	1463	.94	.19	23.5	7649
.01	4359	2.72	.35	68.0	18873
.1	9754	5.69	1.18	142.3	7271
1	15453	8.35	2.94	208.8	2522
10	23653	11.34	6.63	283.5	914
20	27484	12.39	8.42	309.8	677

translated into a downwind distance x The crosswind distance (y) value can be chosen as desired. Then the dose rate at one hour after detonation (the unit-time reference dose, or UTRD, rate) is given by (Ref 1:49)

$$\text{UTRD rate} = k\ f\ Y\ A(x,y) \qquad (30)$$

where k is the "source normalization constant" (Ref 8:453). The quantity f is the fraction of the weapon yield Y due to fission. A(x,y) is the fraction of the activity deposited per square unit area at the location defined by x and y:

$$A(x,y) = \int_0^{\infty} \frac{1}{\sqrt{2\pi}\sigma_x} \exp\left(-\tfrac{1}{2}\left(\frac{x-vt}{\sigma_x}\right)^2\right) \frac{1}{\sqrt{2\pi}\sigma_y} \exp\left(-\tfrac{1}{2}(y/\sigma_y)^2\right) g(t)\,dt \qquad (31)$$

Equation (31) is just an integration of the product of the two normal distributions describing the cloud's horizontal extent, multiplied by g(t), over all time. Actually, the integration need only be carried out over the time the effective cloud is overhead at a particular location, and over this time σ_y is approximately constant for any appreciable velocity v.

Late-Time Approximation

If we expand g(t) about a given t_a, we have (Ref 9)

$$g(t) = g(t_a) + \left(\frac{dg}{dt}\right)_{t_a} (t - t_a) + \ldots \qquad (32)$$

Substituting (32) in (31), factoring out the y-direction distribution, making a change of the variable of integration from t to z where

$$z = \frac{vt-x}{\sigma_x} \tag{33}$$

and integrating, it can be shown that, for x greater than about $3\sigma_x$

$$A(x,y) = \frac{g(t_a)\exp(-\frac{1}{2}(y/\sigma_y)^2)}{v\sqrt{2\pi}\,\sigma_y} \tag{34}$$

Since v is constant, $x=vt_a$, and σ_y is given by (28).

We now have a method of calculating UTRD rate. Along the way we have made a number of simplifying assumptions, and have implicitly decided the way we relate radiation dose to weapon yield through the source normalization constant. The reader is referred to Russell (Ref 5) for a thorough discussion of the various methods employed in arriving at a source normalization constant. We use a source normalization constant of 2500 (roentgens/hour) x mi^2/KT of fission yield converted to appropriate MKS units.

In order to calculate an accumulated radiation dose, we must know the time of arrival of the fallout, the UTRD rate, the time to which we wish to accumulate radiation dose, and some appropriate relation to calculate the falloff of dose rate with time. The time of arrival is taken to be

the distance from ground zero divided by the effective wind velocity. We have just seen a method to calculate UTRD rate. As a worst-case condition, we will accumulate all doses to infinite time. The Way-Wigner relation indicates that, for times of interest here, the dose rate at any time may be given by (Ref 8:451)

$$R(t) = (\text{UTRD rate})t^{-1.2} \qquad (35)$$

Then the accumulated dose to infinite time will be

$$D = \int_{t_a}^{\infty} R(t)dt = 5(\text{UTRD rate})t_a^{-.2} \qquad (36)$$

where t_a is the time of arrival of the fallout.

Plots of equations (35) and (36) are presented in Chapter V and Appendix E. Chapter V discusses the effects of parametric variation of g(t) and the resultant dose rate and accumulated doses.

V Analysis of Computer Runs

This chapter will consider several sets of output from the FALL program illustrating the results of varying the program parameters. Representative sets of output are included for each parametric variation. Additional results will be found in Appendix E. Appendix B contains a guide to interpreting the output.

Parameters are varied from those of a base case defined as: yields of .001, .01, .1, 1.0, 10.0, and 20.0 megatons; WSEG-RM-10 activity-size distribution; wind velocity of 25 km/HR; wind shear of 1.2 km/HR per km of cloud thickness; fission fraction of .5. Figures 3 through 5 are the output for the 1.0 megaton base case. The remaining base case results are contained in Figures E-1 through E-15.

Variation of A(r)

Figures 6 through 17 are the output for a 1.0 megaton yield and from different activity-size distributions (DELFIC's default distribution and three distributions selected from Table I). An examination of the g(t) plots and printouts will demonstrate the dependence of g(t) on A(r). In particular, comparison of Figures 10 and 13 shows the great sensitivity of the location and magnitude of the peak of g(t) to changes in the slope of A(r).

Examination of the dose plots indicates that increasing the slope of A(r) serves to accumulate higher doses closer to ground zero. This is to be expected, as an

examination of Figure 1 will show. A high slope of A(r) indicates a large percentage of radioactivity residing with the largest particles, which fall fastest.

Figures E-16 through E-75 contain the remainder of the program output for the various A(r)'s.

Variation of Wind Shear

Figures 18 through 21 are the printouts and dose plots for the 1.0 megaton case with wind shears of .6 and 2.4 km/HR per km of cloud thickness. (Varying wind shear or velocity does not effect g(t) in this model.) The results indicate that, as wind shear increases, the dose at any point under the cloud centerline will decrease. Therefore, the radioactivity will be spread further in the cross-wind direction. It is possible to study this explicitly for a given problem by specifying a y-offset in the input data.

Figures E-76 through E-95 contain the remainder of the program output for varied wind shear.

Variation of Wind Velocity

Figures 22 and 23 are the output for the 1.0 megaton case with the wind velocity increased to 50 km/HR. Because of the simplified downwind-direction cloud structure assumed, the shapes of the dose plots are unchanged. What does occur is that the pattern is elongated in the downwind direction, with the peak UTRD rate and accumulated dose of one-half the base values occurring twice as far from ground

zero as in the base case.

Figures E-96 through E-105 are the remainder of the 50 km/HR output.

Variation of Fission Fraction

Figures 24 and 25 are the output for the 1.0 megaton case with a fission fraction of 1.0. The dose quantities are simply double those of the base case everywhere. The remainder of the 1.0 fission fraction output is contained in figures E-106 through E-115.

Examination of Various Y-Offsets

Figures 26 through 37 are the output for the 1.0 megaton base case at crosswind offsets of 6, 12, 18, 24, 30, and 36 km from the path of the cloud center. It can be seen how the peak dose values decrease in magnitude and occur further downwind as crosswind distance increases. This results from the assumption of a non-uniform lateral activity distribution in the cloud and lateral cloud growth due to wind shear.

Dose values from offset calculations can be used in the construction of fallout contour plots.

(Text continued on page 61)

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.6 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 794.869 RADS/HR, OCCURRED AT 41.67 KM

MAX ACCUM DOSE, 2213.379 RADS, OCCURRED AT 35.42 KM

ACCUMULATED DOSE OF 988.127 RADS OCCURRED AT 67.50 KM

ACCUMULATED DOSE OF 491.397 RADS OCCURRED AT 127.08 KM

ACCUMULATED DOSE OF 98.705 RADS OCCURRED AT 247.92 KM

UTRD RATE OF 293.952 RADS/HR OCCURRED AT 120.83 KM

UTRD RATE OF 99.089 RADS/HR OCCURRED AT 214.58 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 3

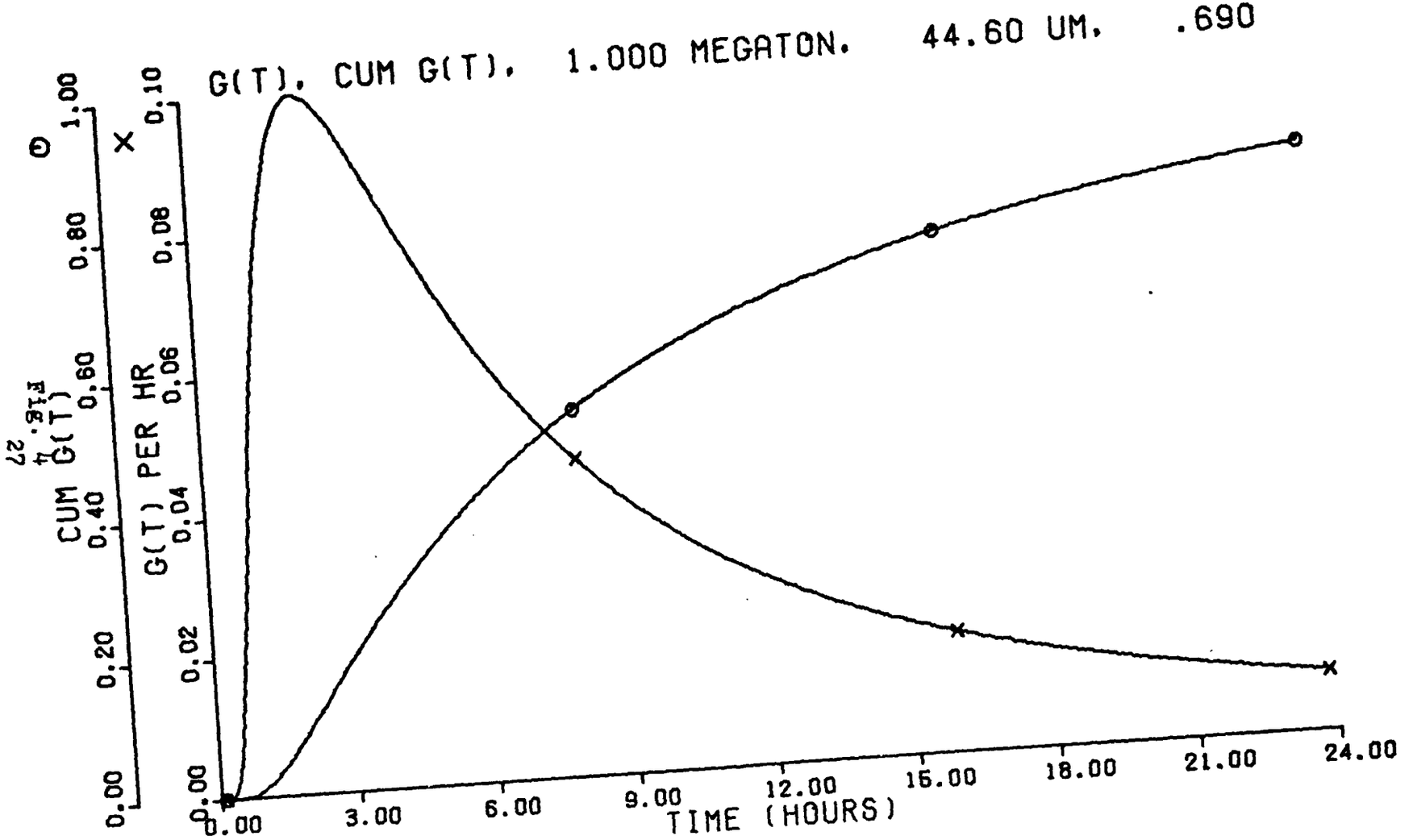
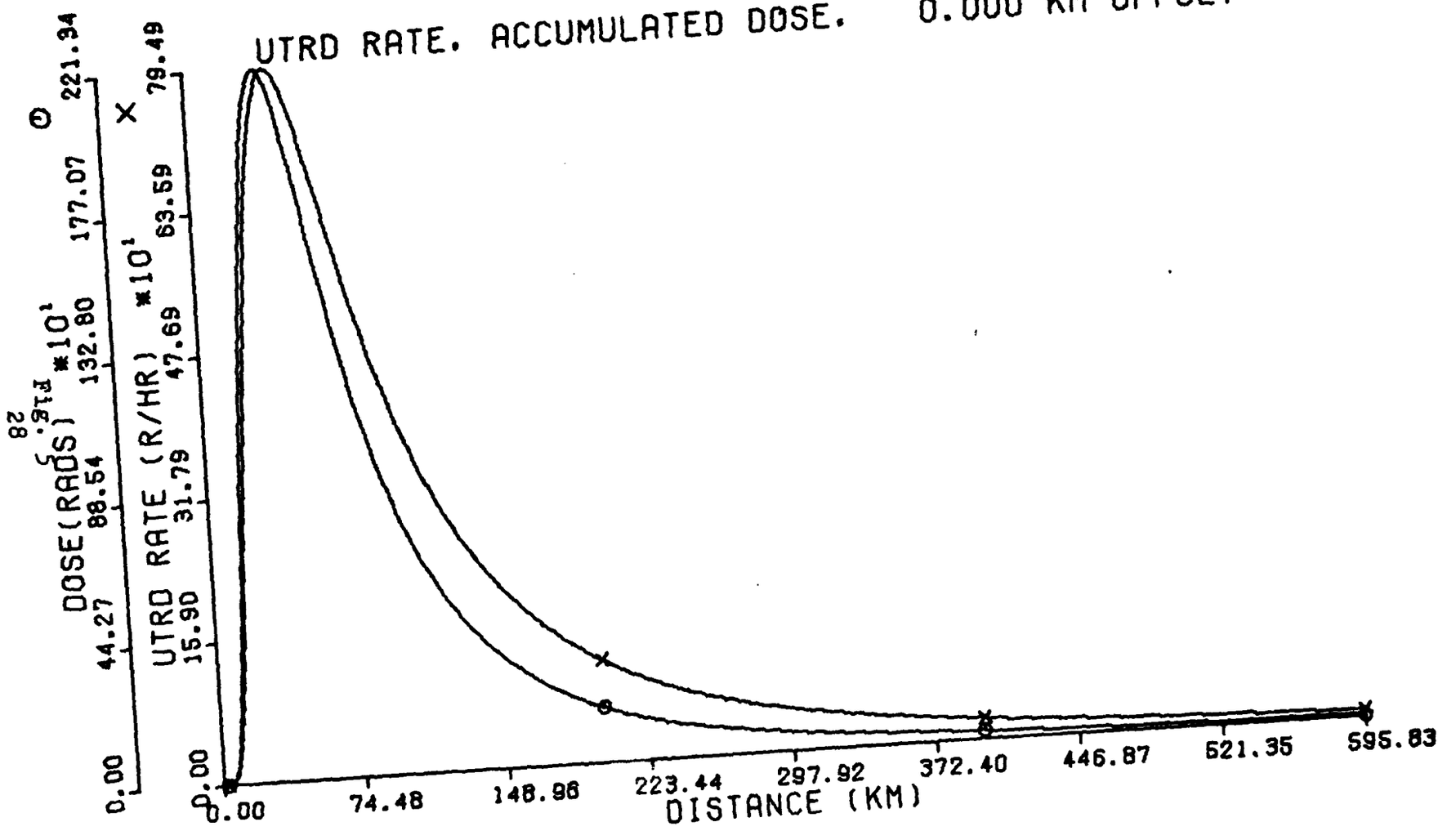

G(T), CUM G(T), 1.000 MEGATON, 44.60 UM, .690
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.02
0.04
0.06
0.08
0.10
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. 4.27


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR) *10¹
Fig. 28
0.00
44.27
88.54
132.80
177.07
221.34
0.00
15.90
31.79
47.69
63.59
79.49
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .15466E+00 PER HR, OCCURRED AT .583 HOURS

MAX UTRD RATE, 2369.030 RADS/HR, OCCURRED AT 10.42 KM

MAX ACCUM DOSE, 10189.318 RADS, OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 966.326 RADS OCCURRED AT 66.67 KM

ACCUMULATED DOSE OF 494.444 RADS OCCURRED AT 91.67 KM

ACCUMULATED DOSE OF 98.489 RADS OCCURRED AT 185.42 KM

UTRD RATE OF 995.712 RADS/HR OCCURRED AT 37.50 KM

UTRD RATE OF 297.215 RADS/HR OCCURRED AT 81.25 KM

UTRD RATE OF 98.280 RADS/HR OCCURRED AT 147.92 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.250	HOURS, CUMULATIVE G(T) IS	.39
AT	7.833	HOURS, CUMULATIVE G(T) IS	.46
AT	10.417	HOURS, CUMULATIVE G(T) IS	.51
AT	13.000	HOURS, CUMULATIVE G(T) IS	.54
AT	15.583	HOURS, CUMULATIVE G(T) IS	.57
AT	18.167	HOURS, CUMULATIVE G(T) IS	.60
AT	20.750	HOURS, CUMULATIVE G(T) IS	.62
AT	23.333	HOURS, CUMULATIVE G(T) IS	.64

Fig. 6

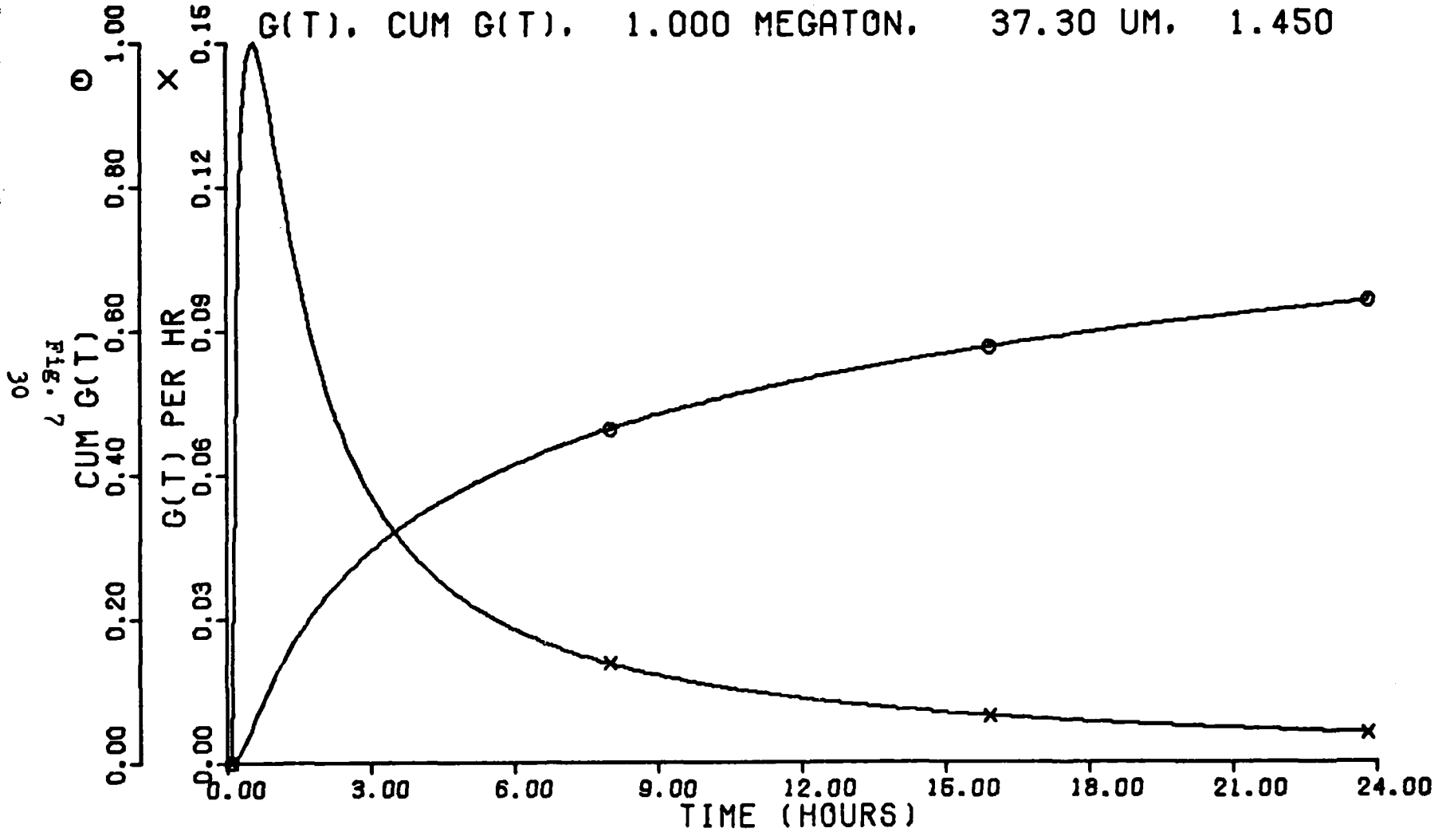

G(T), CUM G(T), 1.000 MEGATON, 37.30 UM, 1.450
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.03
0.06
0.09
0.12
0.15
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. 7

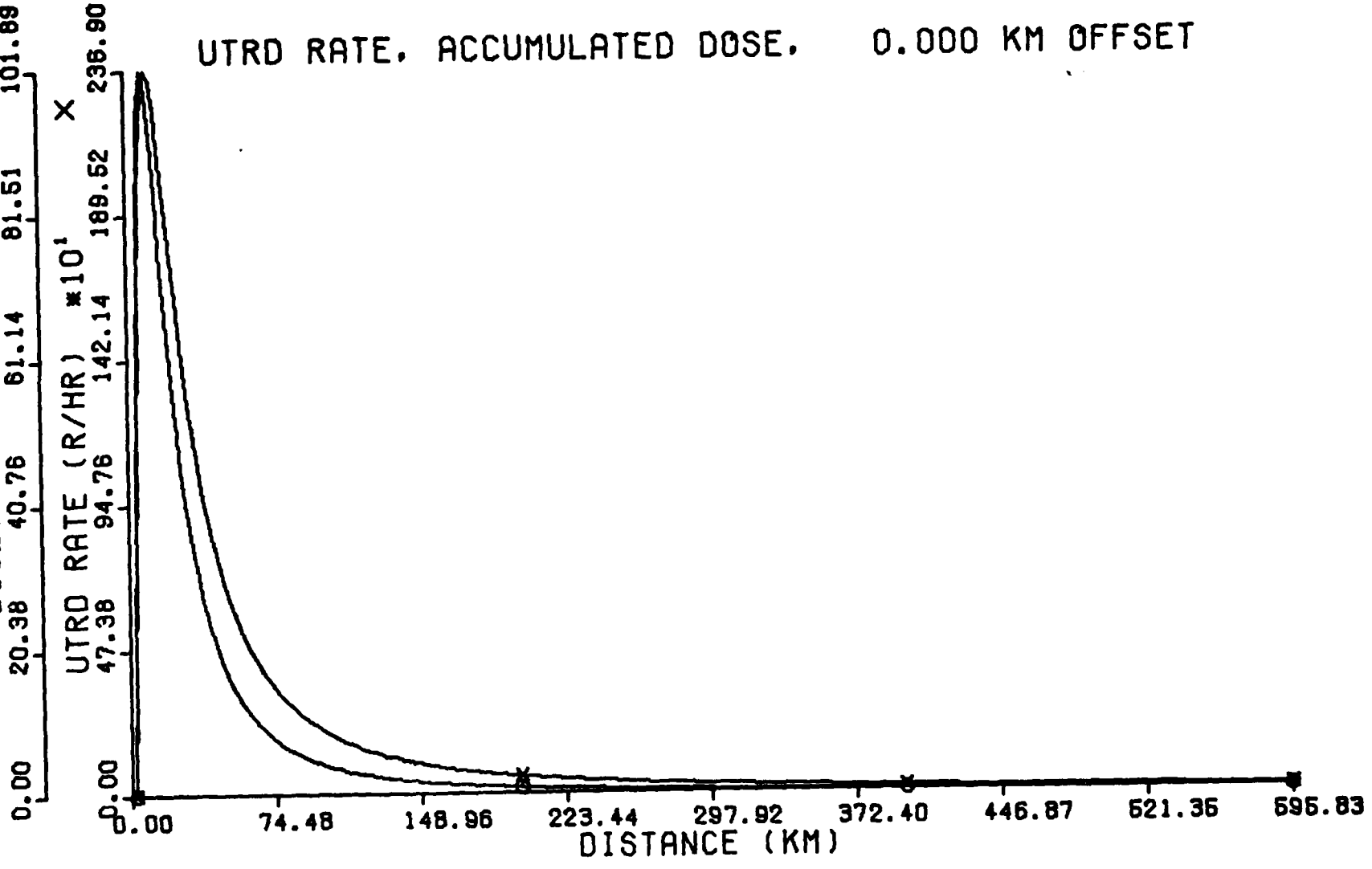

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10¹
0.00
20.38
40.76
61.14
81.51
101.89
0.00
47.38
94.76
142.14
189.52
236.90
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. 8

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .25563E+00 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 1540.476 RADS/HR, OCCURRED AT 58.75 KM

MAX ACCUM DOSE, 3554.895 RADS, OCCURRED AT 64.58 KM

ACCUMULATED DOSE OF 952.734 RADS OCCURRED AT 129.17 KM

ACCUMULATED DOSE OF 498.179 RADS OCCURRED AT 152.08 KM

ACCUMULATED DOSE OF 99.640 RADS OCCURRED AT 210.42 KM

UTRD RATE OF 994.891 RADS/HR OCCURRED AT 102.08 KM

UTRD RATE OF 294.753 RADS/HR OCCURRED AT 152.08 KM

UTRD RATE OF 97.051 RADS/HR OCCURRED AT 195.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.18
AT	5.250	HOURS, CUMULATIVE G(T) IS	.73
AT	7.833	HOURS, CUMULATIVE G(T) IS	.92
AT	10.417	HOURS, CUMULATIVE G(T) IS	.98
AT	13.000	HOURS, CUMULATIVE G(T) IS	.99
AT	15.583	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.167	HOURS, CUMULATIVE G(T) IS	1.00
AT	20.750	HOURS, CUMULATIVE G(T) IS	1.00
AT	23.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. 9

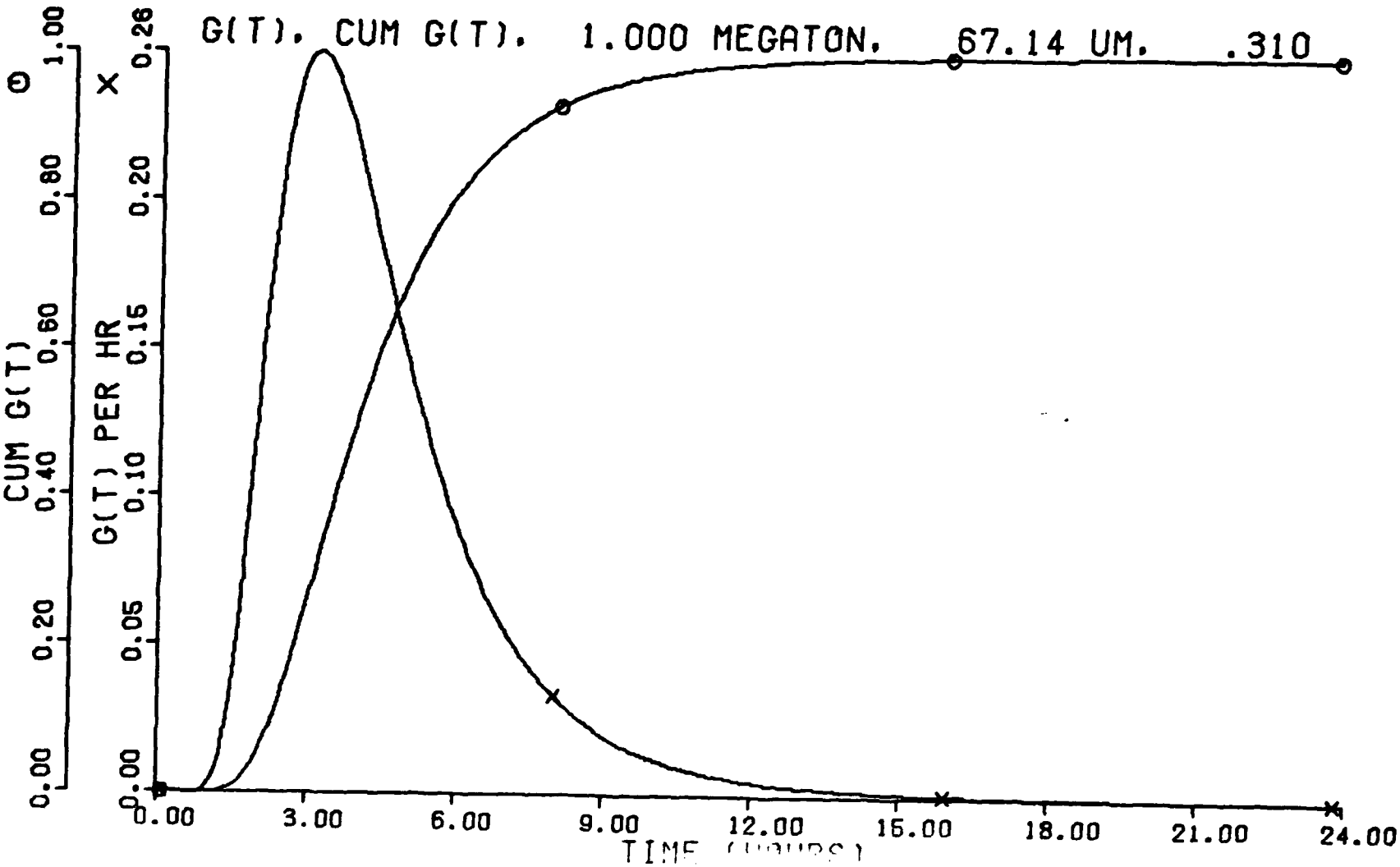

G(T), CUM G(T), 1.000 MEGATON, 67.14 UM, .310
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.05
0.10
0.15
0.20
0.25
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. 10

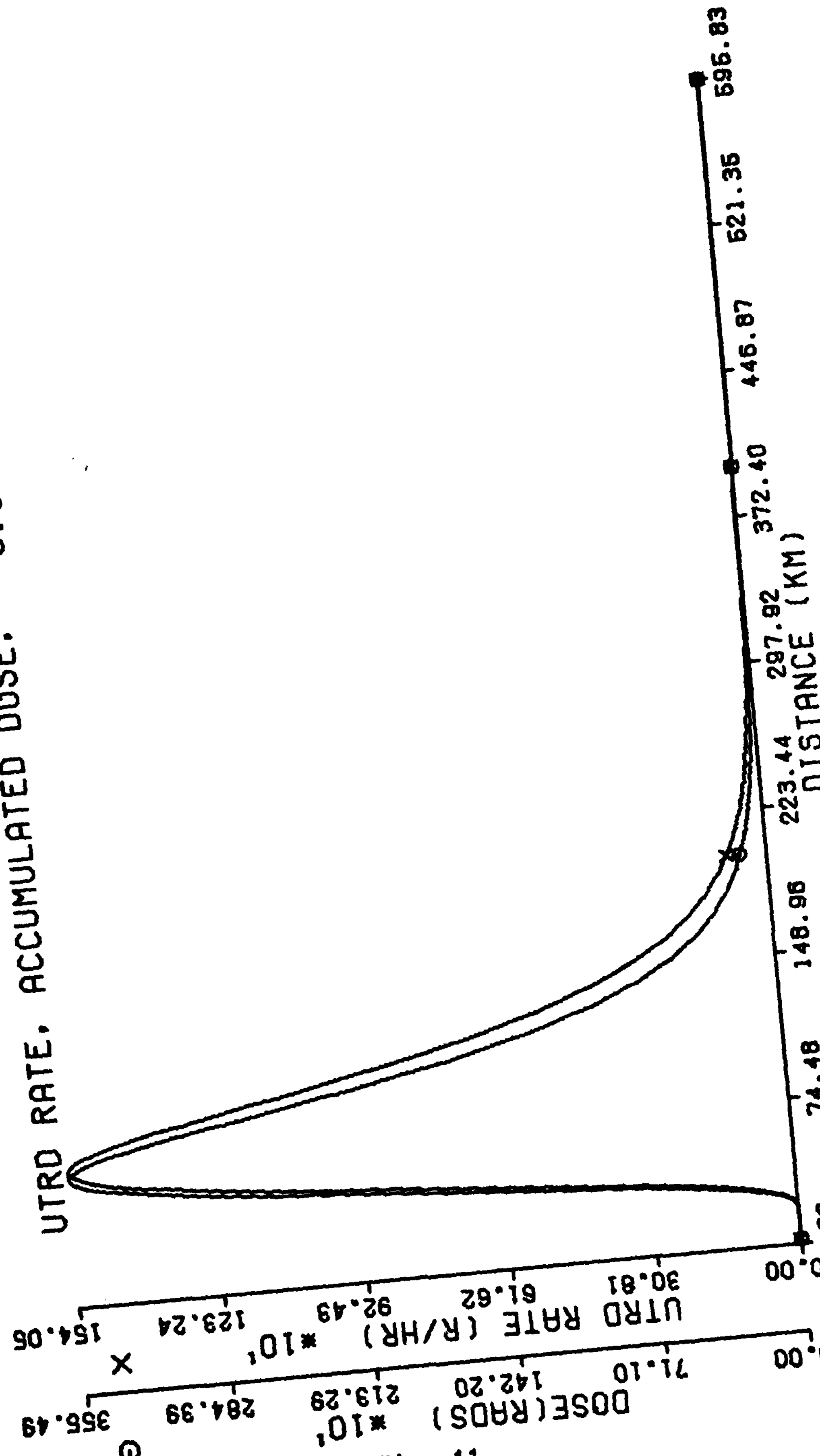

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)
0.00
30.81
61.62
92.43
123.24
154.06
UTRD RATE (R/HR) *10¹
0.00
71.10
142.20
213.29
284.39
355.49
DOSE(RADS) *10¹

Fig. 11

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .30868E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 5091.761 RADS/HR, OCCURRED AT 6.25 KM

MAX ACCUM DOSE, 24456.672 RADS, OCCURRED AT 5.25 KM

ACCUMULATED DOSE OF 958.878 RADS OCCURRED AT 70.83 KM

ACCUMULATED DOSE OF 499.674 RADS OCCURRED AT 93.75 KM

ACCUMULATED DOSE OF 98.014 RADS OCCURRED AT 181.25 KM

UTRD RATE OF 2851.115 RADS/HR OCCUPRED AT 20.83 KM

UTRD RATE OF 933.902 RADS/HR OCCUPRED AT 45.83 KM

UTRD RATE OF 294.111 RADS/HR OCCUPRED AT 85.42 KM

UTRD RATE OF 98.799 RADS/HR OCCUPRED AT 145.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.42
AT	5.250	HOURS, CUMULATIVE G(T) IS	.55
AT	7.833	HOURS, CUMULATIVE G(T) IS	.61
AT	10.417	HOURS, CUMULATIVE G(T) IS	.66
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.71
AT	18.167	HOURS, CUMULATIVE G(T) IS	.73
AT	20.750	HOURS, CUMULATIVE G(T) IS	.75
AT	23.333	HOURS, CUMULATIVE G(T) IS	.76

Fig. 12

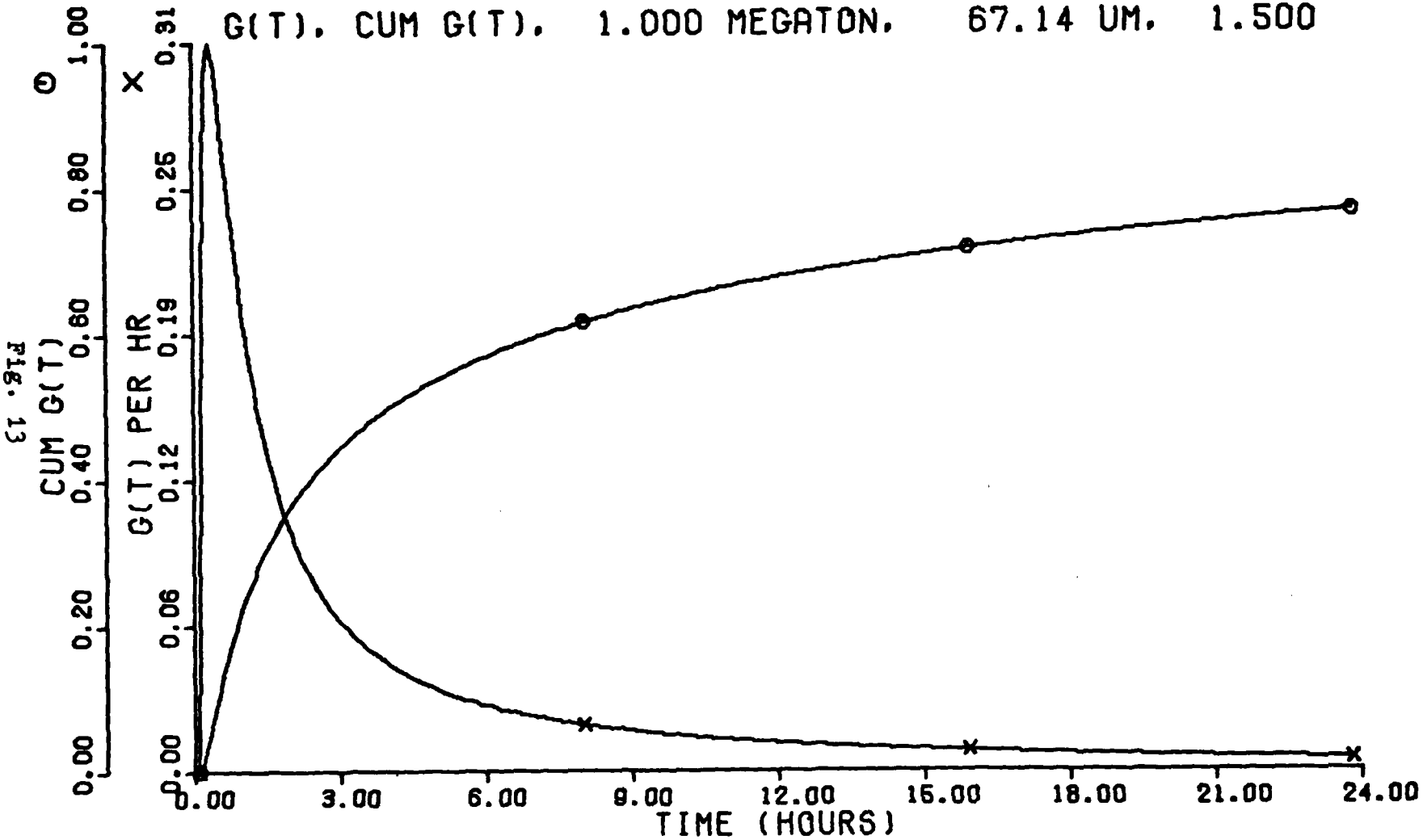
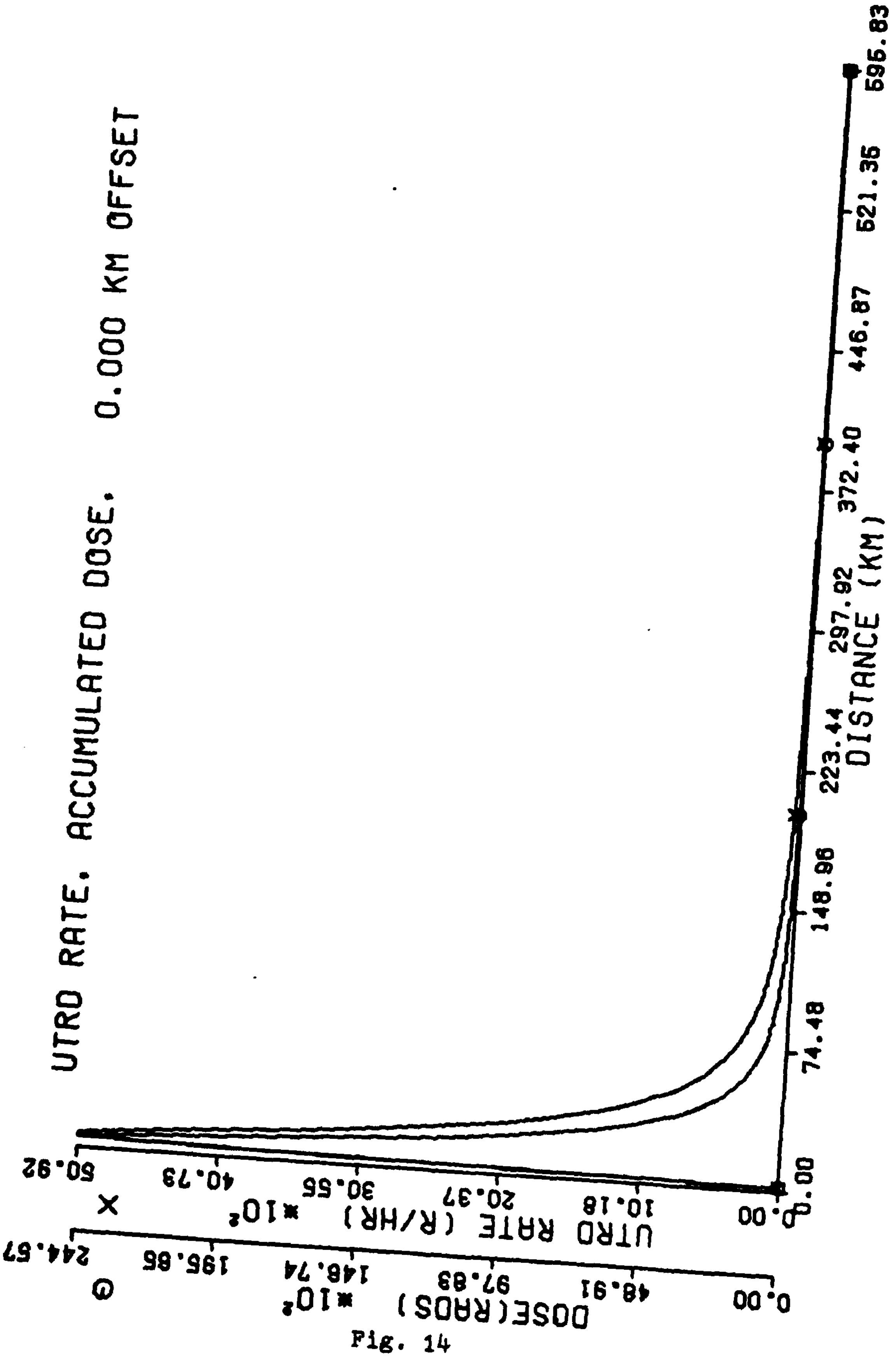

G(T). CUM G(T). 1.000 MEGATON. 67.14 UM. 1.500
O
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.06
0.12
0.19
0.25
0.31
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. 13



UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)
X
0.00
10.18
20.37
30.56
40.73
50.92
UTRD RATE (R/HR) ×10²
0.00
48.91
97.83
146.74
195.66
244.57
DOSE(RADS) ×10²

Fig. 14

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .30

MAX G(T), .46793E+00 PER HR, OCCURRED AT .583 HOURS

MAX UTRD RATE, 6814.162 RADS/HR, OCCURRED AT 12.50 KM

MAX ACCUM DOSE, 26910.065 RADS, OCCURRED AT 12.50 KM

ACCUMULATED DOSE OF 965.192 RADS OCCURRED AT 31.25 KM

ACCUMULATED DOSE OF 493.997 RADS OCCURRED AT 102.08 KM

ACCUMULATED DOSE OF 98.184 RADS OCCURRED AT 170.83 KM

UTRD RATE OF 2709.274 RADS/HR OCCURRED AT 35.42 KM

UTRD RATE OF 987.260 RADS/HR OCCURRED AT 58.33 KM

UTRD RATE OF 294.226 RADS/HR OCCURRED AT 95.83 KM

UTRD RATE OF 99.032 RADS/HR OCCURRED AT 143.75 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083 HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667 HOURS, CUMULATIVE G(T) IS	.68
AT	5.250 HOURS, CUMULATIVE G(T) IS	.84
AT	7.833 HOURS, CUMULATIVE G(T) IS	.90
AT	10.417 HOURS, CUMULATIVE G(T) IS	.93
AT	13.000 HOURS, CUMULATIVE G(T) IS	.95
AT	15.583 HOURS, CUMULATIVE G(T) IS	.96
AT	18.167 HOURS, CUMULATIVE G(T) IS	.97
AT	20.750 HOURS, CUMULATIVE G(T) IS	.97
AT	23.333 HOURS, CUMULATIVE G(T) IS	.98

Fig. 15

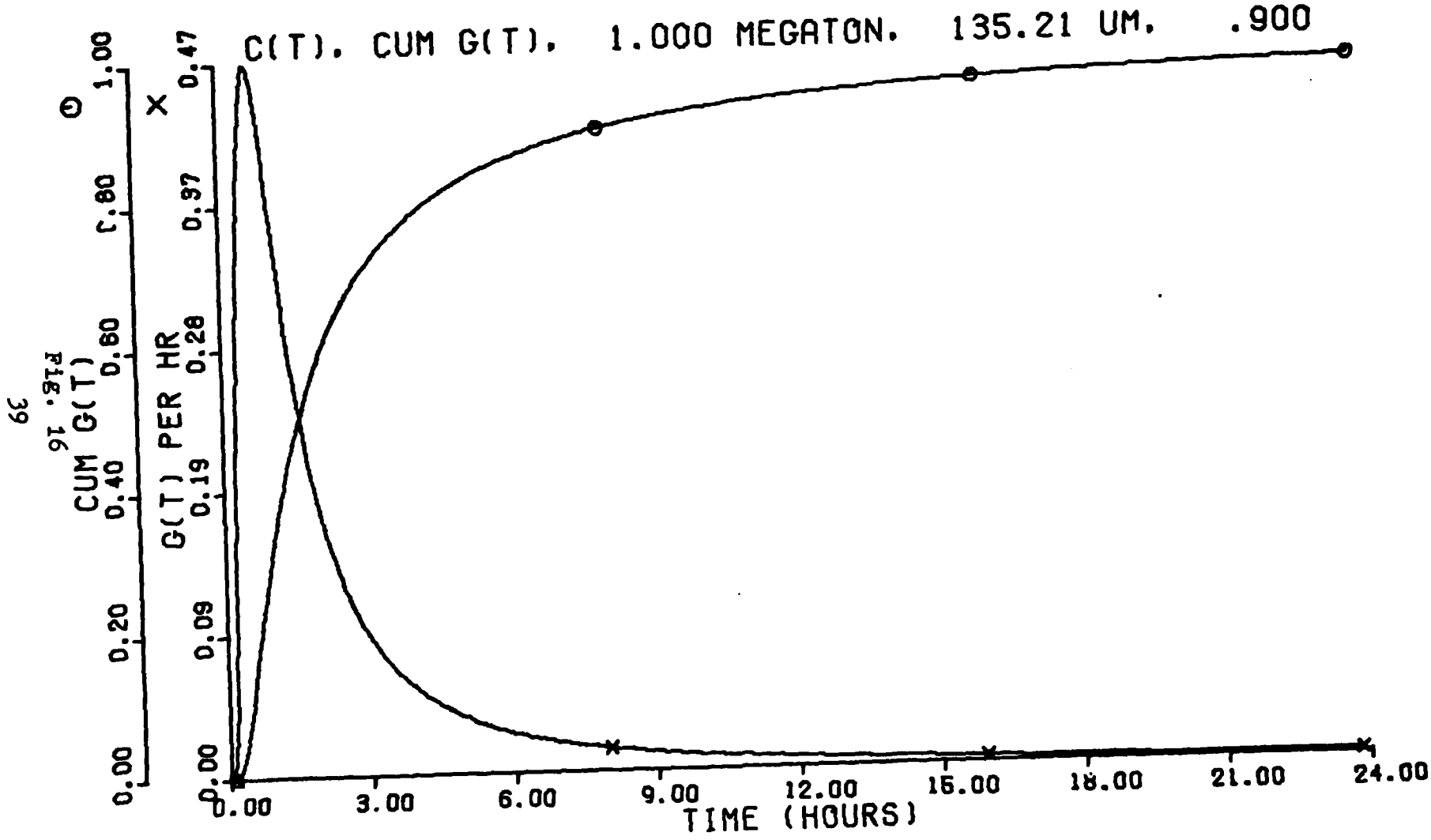
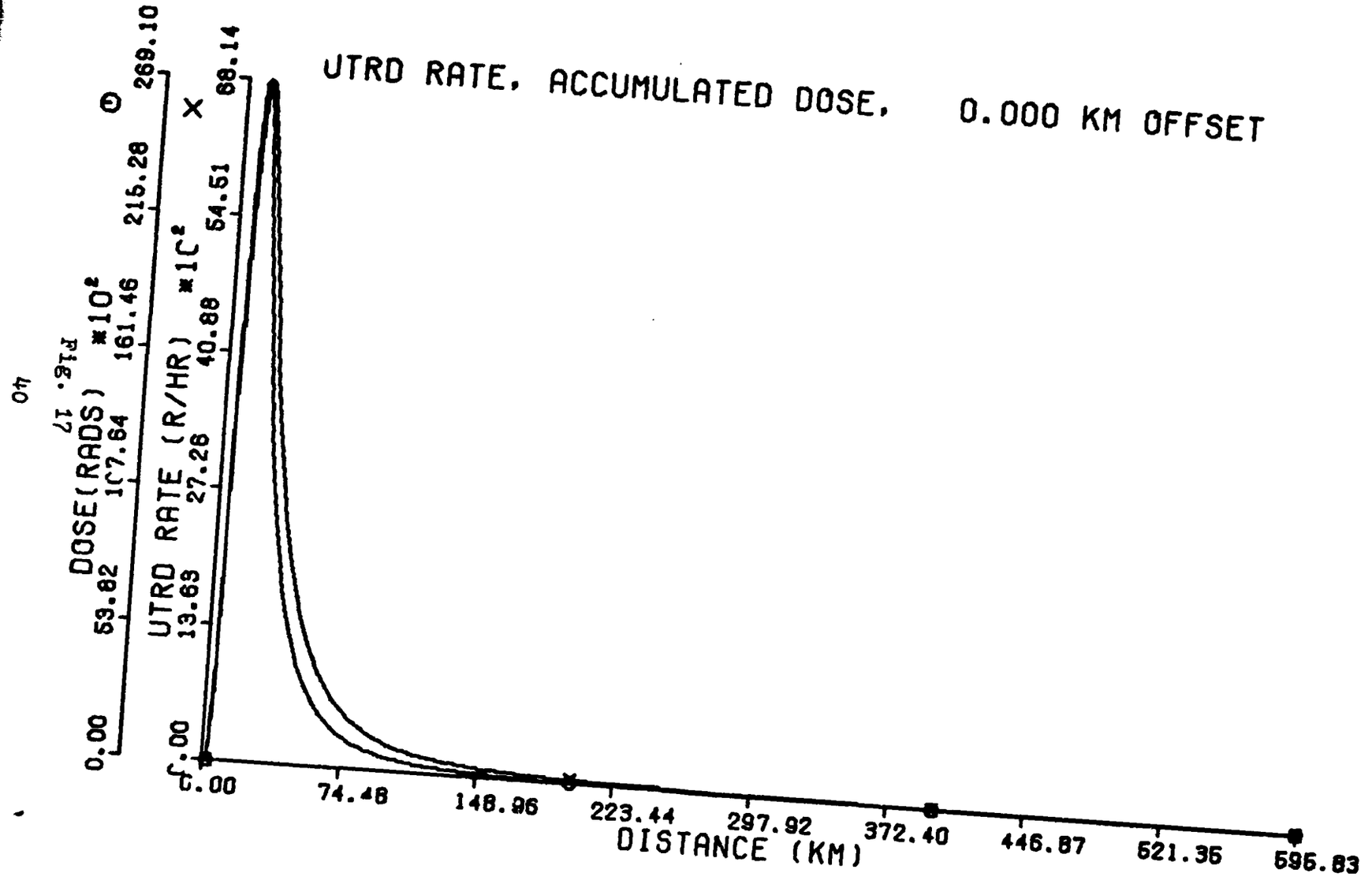

C(T). CUM G(T). 1.000 MEGATON. 135.21 UM. .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.09
0.19
0.28
0.37
0.47
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

FIG. 16


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10²
0.00
53.82
107.64
161.46
215.28
269.10
0.00
13.63
27.26
40.88
54.51
68.14
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 985.089 RADS/HR, OCCURRED AT 45.83 KM

MAX ACCUM DOSE, 2670.110 RADS, OCCURRED AT 39.58 KM

ACCUMULATED DOSE OF 977.745 RADS OCCURRED AT 110.42 KM

ACCUMULATED DOSE OF 499.890 RADS OCCURRED AT 156.25 KM

ACCUMULATED DOSE OF 99.743 RADS OCCURRED AT 302.08 KM

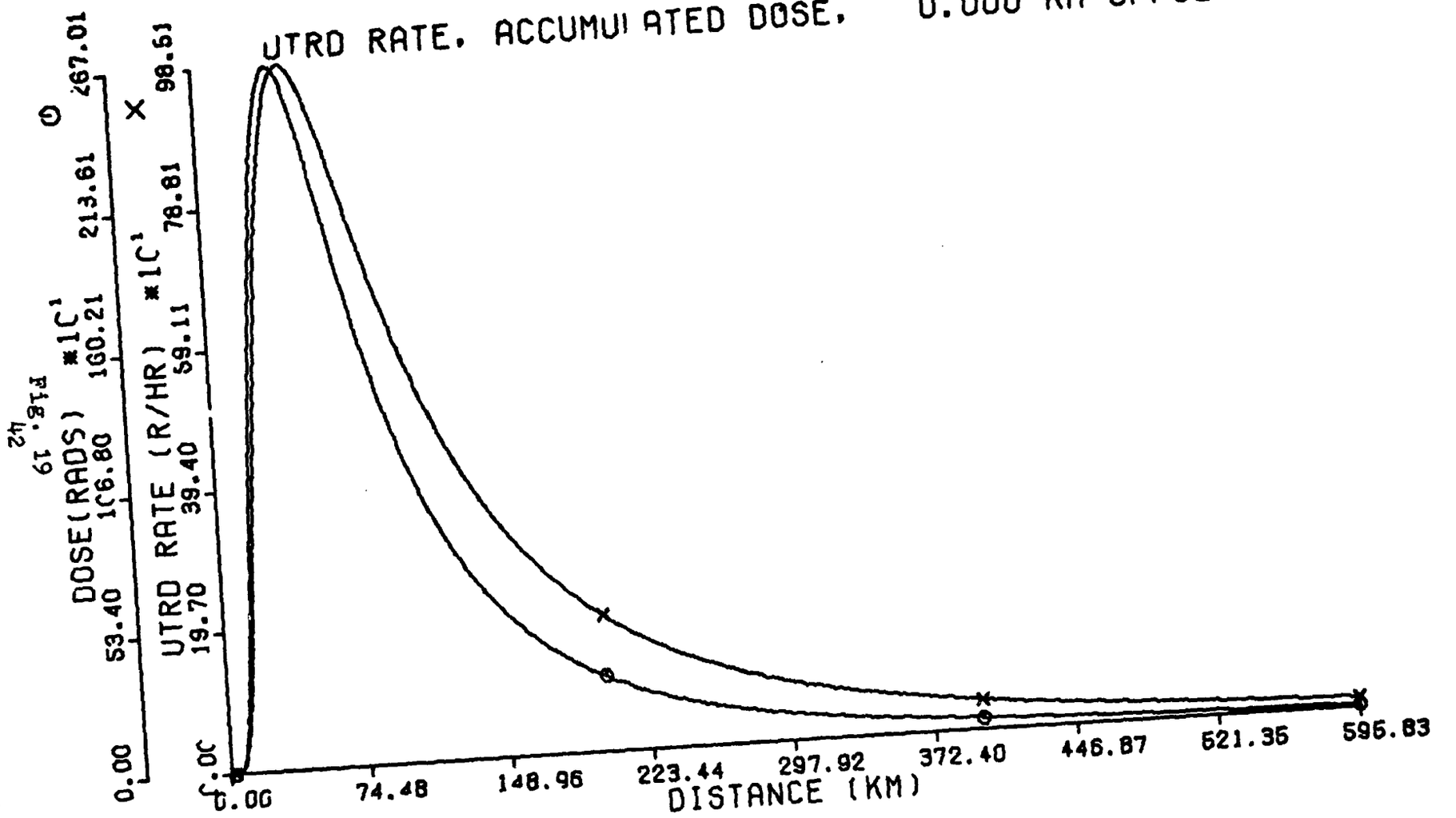
UTRD RATE OF 299.090 RADS/HR OCCURRED AT 156.25 KM

UTRD RATE OF 98.941 RADS/HR OCCURRED AT 275.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T)	IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T)	IS	.16
AT	5.250	HOURS, CUMULATIVE G(T)	IS	.37
AT	7.833	HOURS, CUMULATIVE G(T)	IS	.52
AT	10.417	HOURS, CUMULATIVE G(T)	IS	.62
AT	13.000	HOURS, CUMULATIVE G(T)	IS	.69
AT	15.583	HOURS, CUMULATIVE G(T)	IS	.74
AT	18.167	HOURS, CUMULATIVE G(T)	IS	.78
AT	20.750	HOURS, CUMULATIVE G(T)	IS	.81
AT	23.333	HOURS, CUMULATIVE G(T)	IS	.84

Fig. 18


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *1C¹
UTRD RATE (R/HR) *1C¹
0.00
53.40
106.80
160.21
213.61
267.01
0.00
19.70
39.40
59.11
78.81
98.51
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)
Fig. 19
42

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 524.094 RADS/HR, OCCURRED AT 37.50 KM

MAX ACCUM DOSE, 1505.587 RADS, OCCURRED AT 33.33 KM

ACCUMULATED DOSE OF 997.751 RADS OCCURRED AT 50.42 KM

ACCUMULATED DOSE OF 498.991 RADS OCCURRED AT 93.75 KM

ACCUMULATED DOSE OF 99.506 RADS OCCURRED AT 133.75 KM

UTRD RATE OF 298.332 RADS/HR OCCURRED AT 81.25 KM

UTRD RATE OF 98.419 RADS/HR OCCURRED AT 158.33 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 20

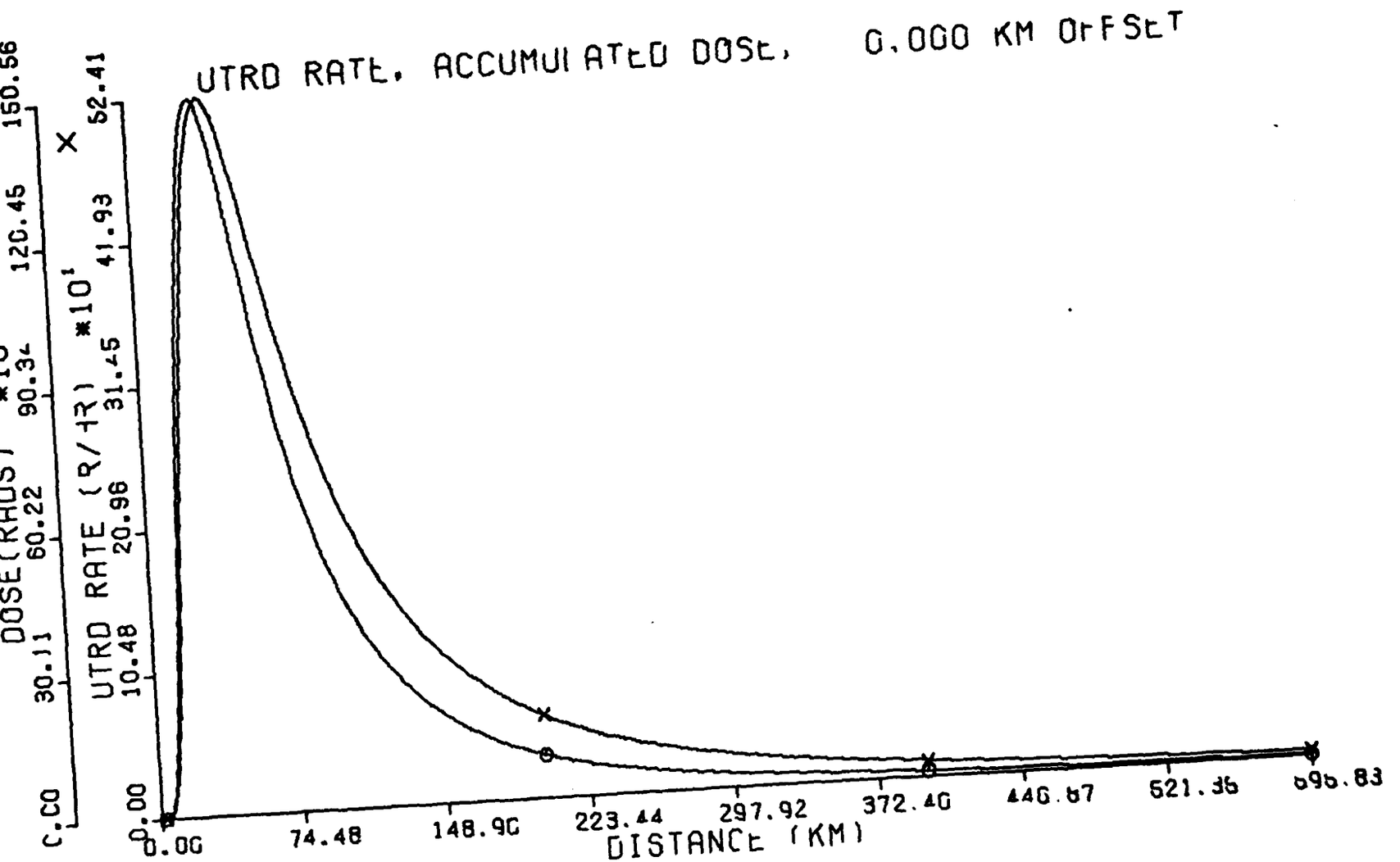

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR) *10¹
0.00
30.11
60.22
90.34
120.45
150.56
0.00
10.48
20.96
31.45
41.93
52.41
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

Fig. 21

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 397.426 RADS/HR, OCCURRED AT 93.33 KM

MAX ACCUM DOSE, 1106.666 RADS, OCCURRED AT 70.83 KM

ACCUMULATED DOSE OF 979.367 RADS OCCURRED AT 100.00 KM

ACCUMULATED DOSE OF 494.056 RADS OCCURRED AT 175.00 KM

ACCUMULATED DOSE OF 98.747 RADS OCCURRED AT 379.17 KM

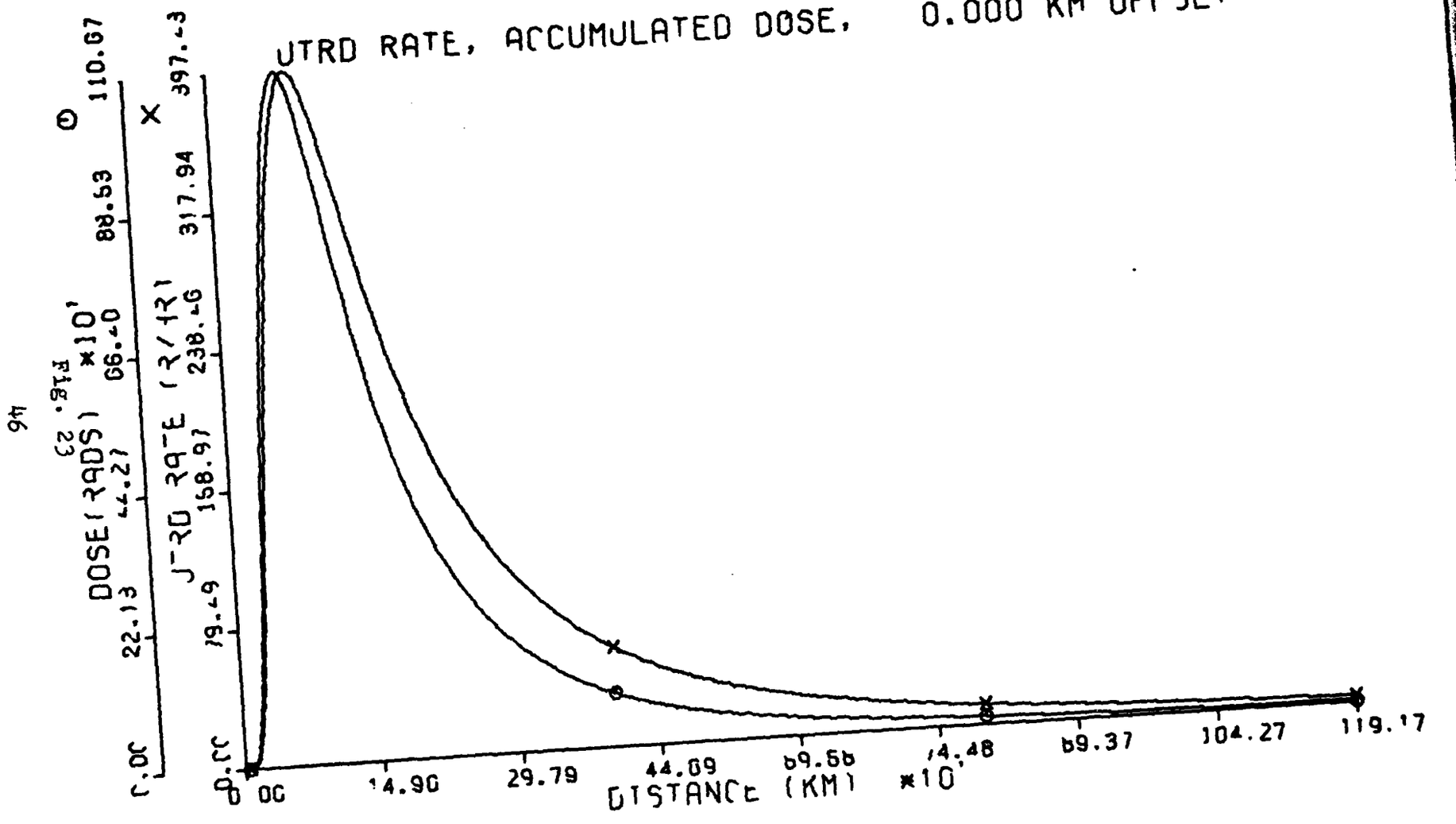
UTRD RATE OF 299.425 RADS/HR OCCURRED AT 141.67 KM

UTRD RATE OF 98.405 RADS/HR OCCURRED AT 304.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 22

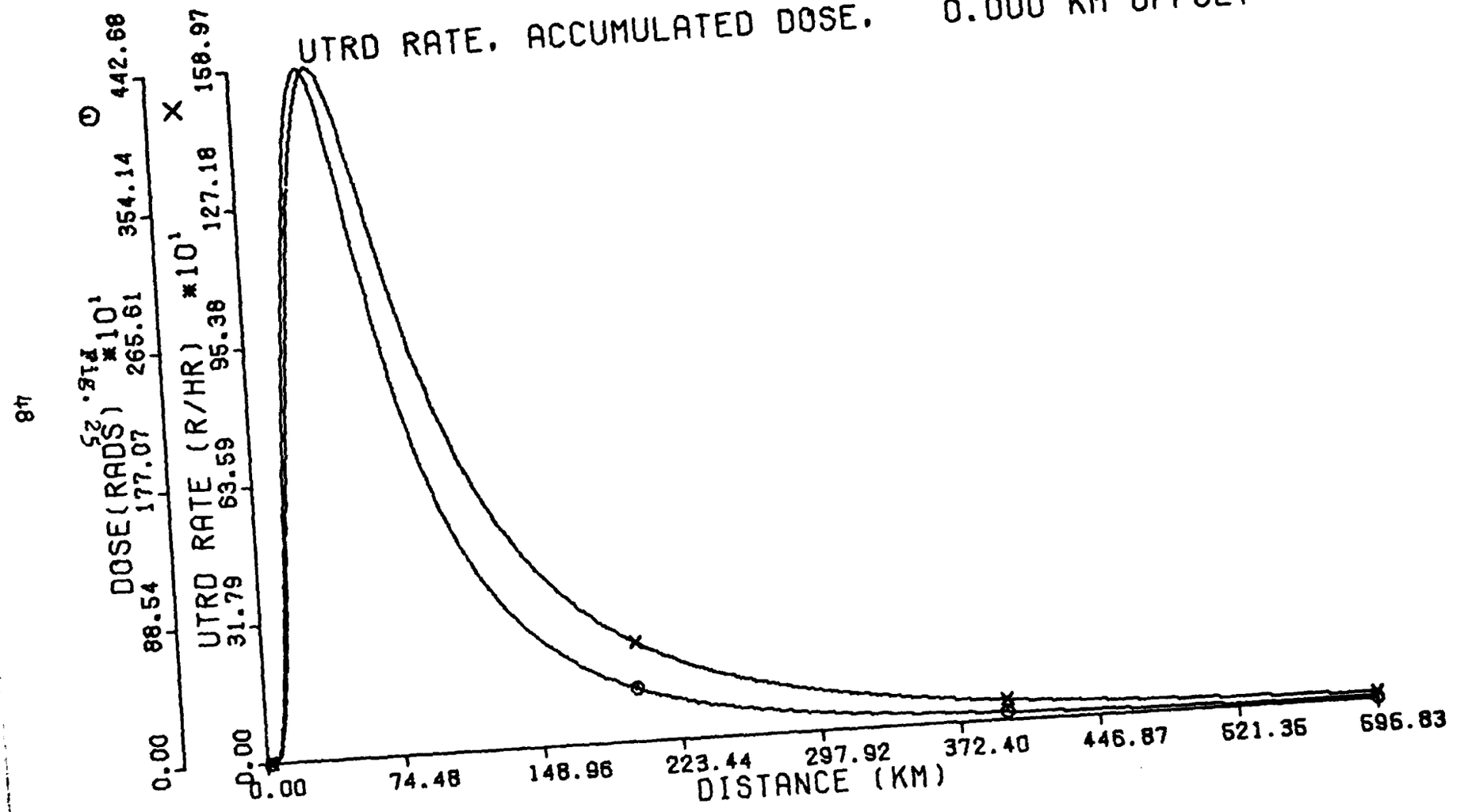

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10'
UTRD RATE (R/HR)
DISTANCE (KM) *10
0.00
22.13
44.27
66.40
88.53
110.67
19.79
158.97
238.46
317.94
397.43
0.00
14.90
29.79
44.69
59.58
74.48
89.37
104.27
119.17

```
YIELD    1.000 MEGATONS
FISSION FRACTION  1.00
INITIAL TIME   .083 HOURS
FINAL TIME  24.000 HOURS
CLOUD CENTER HEIGHT 15453.4 METERS
3-SIGMA CLOUD THICKNESS 11990.0 METERS
INITIAL HORIZONTAL CLOUD RADIUS    2.64 KM
Y-OFFSET    0.00 KM
WIND VELOCITY   25.00 KM/HR
WIND SHEAR   1.20 KM/HR PER KM OF CLOUD THICKNESS
A(R) PARAMETERS:  MEAN   44.60 MICRONS, SLOPE   .59
MAX G(T),   .98357E-01 PER HR, OCCURRED AT   2.417 HOURS
MAX UTRD RATE,   1589.738 RADS/HR, OCCURRED AT    41.67 KM
MAX ACCUM DOSE,   4426.758 RADS, OCCURRED AT    35.42 KM
ACCUMULATED DOSE OF    982.793 RADS OCCURRED AT  127.08 KM
ACCUMULATED DOSE OF    493.745 RADS OCCURRED AT  172.92 KM
ACCUMULATED DOSE OF     99.321 RADS OCCURRED AT  316.67 KM
UTRD RATE OF   971.236 RADS/HR OCCURRED AT    85.42 KM
UTRD RATE OF   294.123 RADS/HR OCCURRED AT   177.08 KM
UTRD RATE OF    99.489 RADS/HR OCCURRED AT   291.67 KM

 SELECTED CUMULATIVE G(T) DATA

AT    .083 HOURS, CUMULATIVE G(T) IS    0.00
AT   2.667 HOURS, CUMULATIVE G(T) IS    .16
AT   5.250 HOURS, CUMULATIVE G(T) IS    .37
AT   7.833 HOURS, CUMULATIVE G(T) IS    .52
AT  10.417 HOURS, CUMULATIVE G(T) IS    .62
AT  13.000 HOURS, CUMULATIVE G(T) IS    .69
AT  15.583 HOURS, CUMULATIVE G(T) IS    .74
AT  18.167 HOURS, CUMULATIVE G(T) IS    .78
AT  20.750 HOURS, CUMULATIVE G(T) IS    .81
AT  23.333 HOURS, CUMULATIVE G(T) IS    .84
```

Fig. 24


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR) *10¹
0.00
88.54
177.07
265.61
354.14
442.68
0.00
31.79
63.59
95.38
127.18
158.97
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 6.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .63

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 501.580 RADS/HR, OCCURRED AT 54.17 KM

MAX ACCUM DOSE, 1279.862 RADS, OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 987.095 RADS OCCURRED AT 75.00 KM

ACCUMULATED DOSE OF 488.674 RADS OCCURRED AT 120.83 KM

ACCUMULATED DOSE OF 97.956 RADS OCCURRED AT 215.83 KM

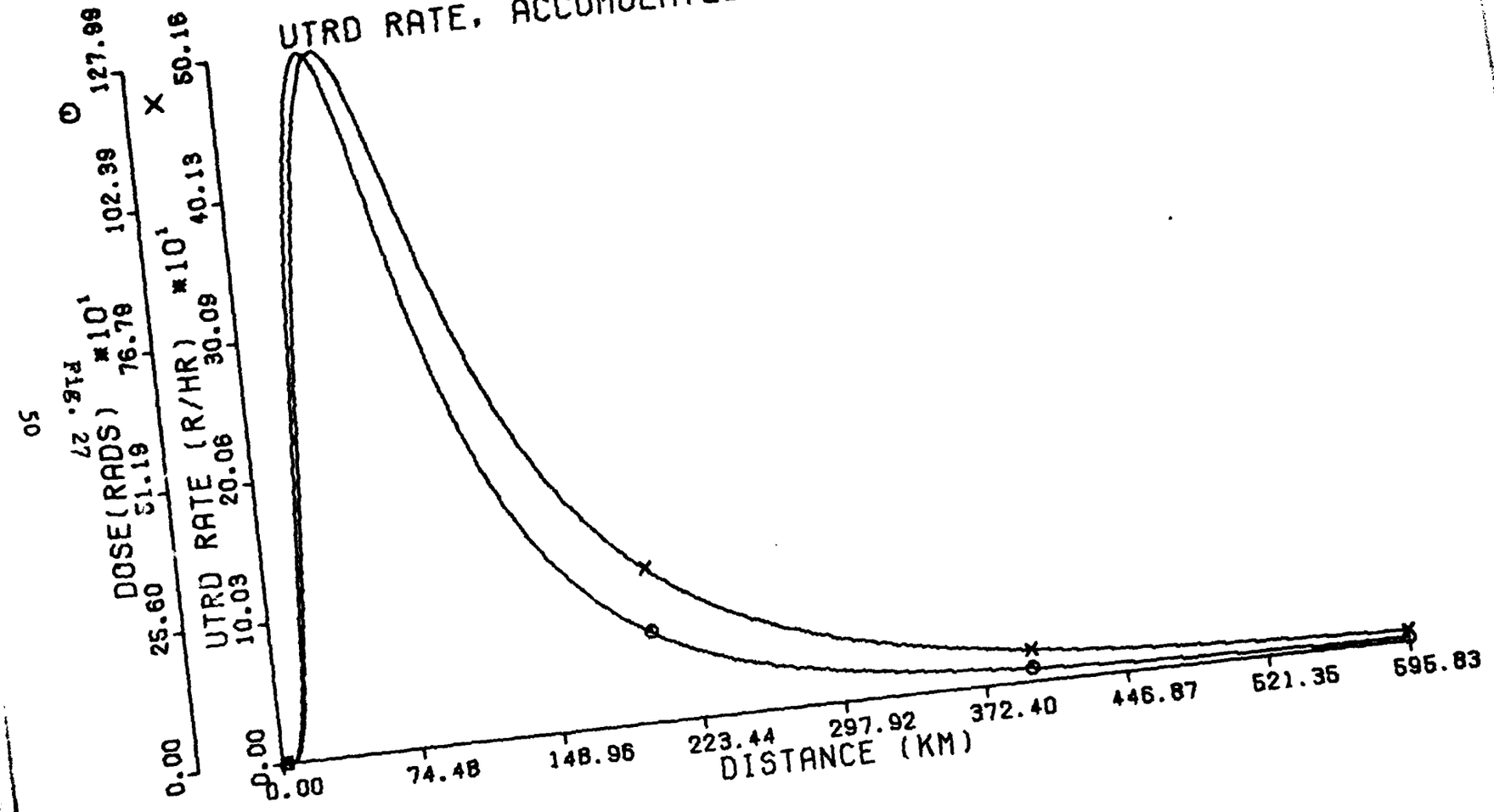
UTRD RATE OF 298.656 RADS/HR OCCURRED AT 110.42 KM

UTRD RATE OF 99.198 RADS/HR OCCURRED AT 210.42 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 26


UTRD RATE, ACCUMULATED DOSE, 6.000 KM OFFSET
DOSE(RADS) *10¹
0.00
25.60
51.19
76.78
102.39
127.99
UTRD RATE (R/HR) *10¹
0.00
10.03
20.06
30.09
40.13
50.16
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 12.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .65

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 223.142 RADS/HR, OCCURRED AT 85.42 KM

MAX ACCUM DOSE, 482.474 RADS, OCCURRED AT 77.08 KM

ACCUMULATED DOSE OF 99.388 RADS OCCURRED AT 235.42 KM

UTRD RATE OF 99.742 RADS/HR OCCURRED AT 195.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 28

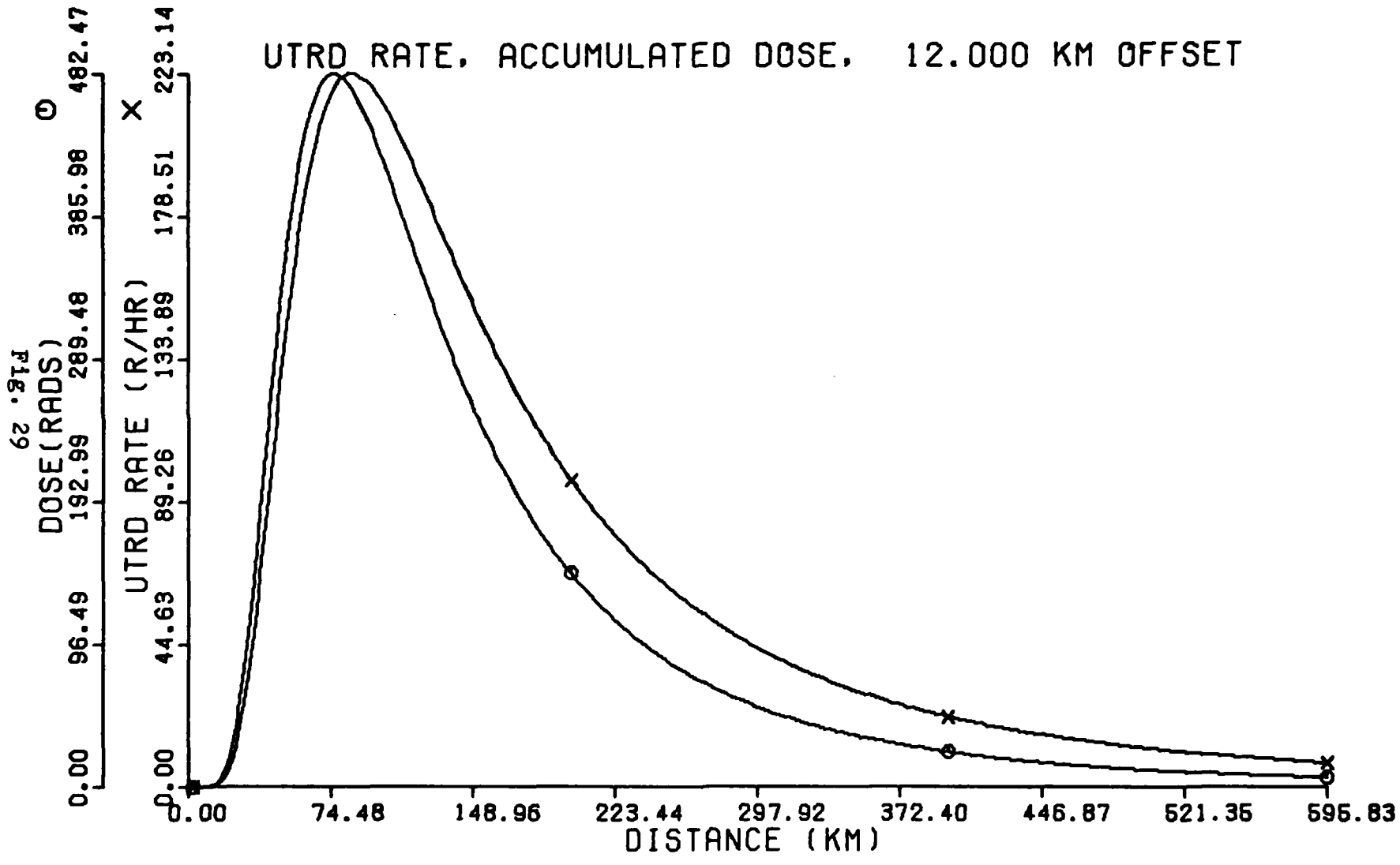

UTRD RATE, ACCUMULATED DOSE, 12.000 KM OFFSET
DOSE(RADS)
0.00
96.49
192.99
289.48
385.98
482.47
UTRD RATE (R/HR)
0.00
44.63
89.26
133.89
178.51
223.14
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. 29

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 18.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .63

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 110.086 RADS/HR, OCCURRED AT 122.92 KM

MAX ACCUM DOSE, 207.132 RADS, OCCURRED AT 110.42 KM

ACCUMULATED DOSE OF 99.748 RADS OCCURRED AT 216.67 KM

UTRD RATE OF 99.043 RADS/HR OCCURRED AT 158.33 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 30

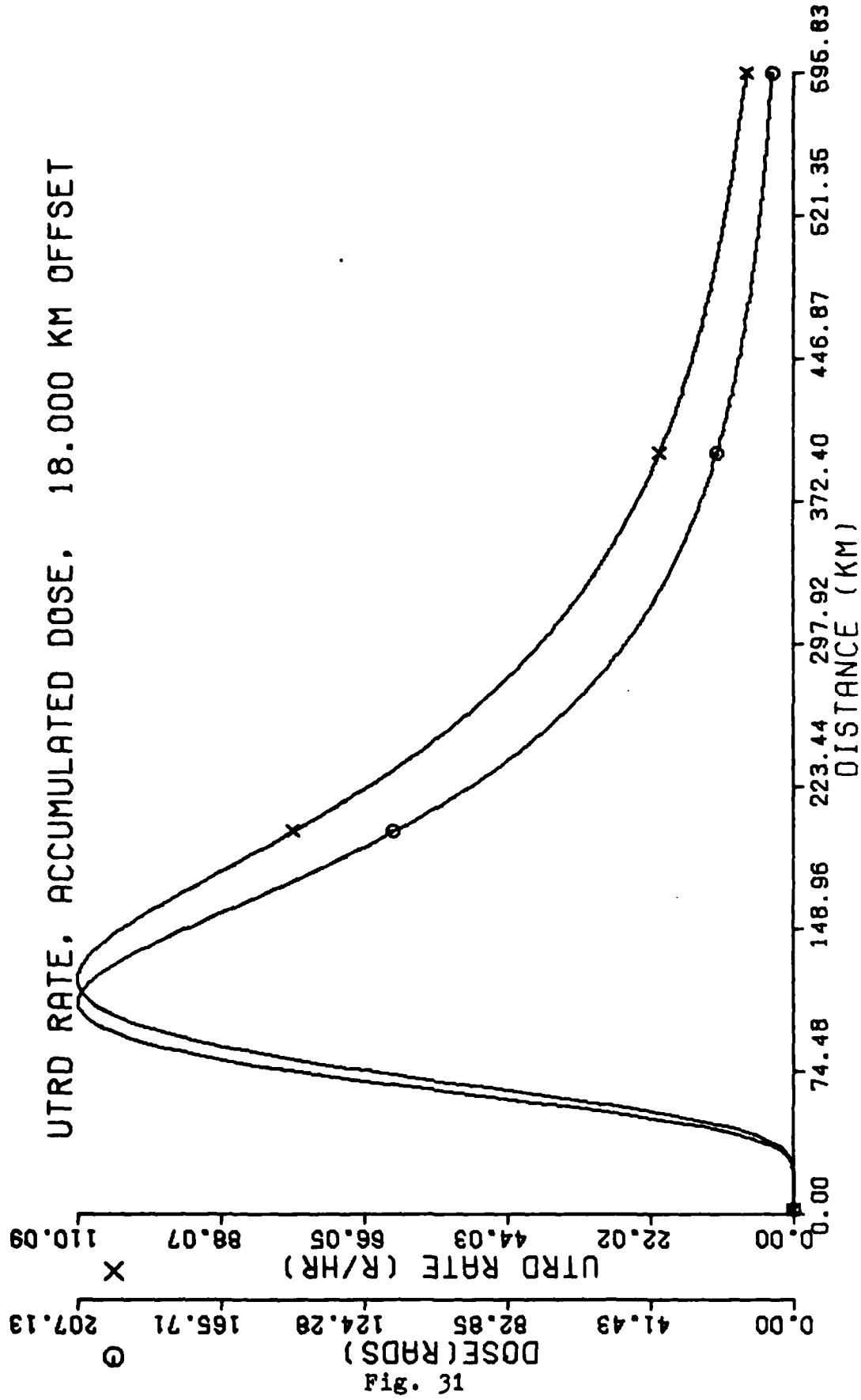

UTRD RATE, ACCUMULATED DOSE, 18.000 KM OFFSET
DISTANCE (KM)
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
696.83
UTRD RATE (R/HR)
0.00
22.02
44.03
66.05
88.07
110.09
DOSE(RADS)
0.00
41.43
82.85
124.28
165.71
207.13

Fig. 31

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 24.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 61.580 RADS/HR, OCCURRED AT 150.42 KM

MAX ACCUM DOSE, 103.839 RADS, OCCURRED AT 145.83 KM

ACCUMULATED DOSE OF 99.917 RADS OCCURRED AT 186.67 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T)	IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T)	IS	.16
AT	5.250	HOURS, CUMULATIVE G(T)	IS	.37
AT	7.833	HOURS, CUMULATIVE G(T)	IS	.52
AT	10.417	HOURS, CUMULATIVE G(T)	IS	.62
AT	13.000	HOURS, CUMULATIVE G(T)	IS	.69
AT	15.583	HOURS, CUMULATIVE G(T)	IS	.74
AT	18.167	HOURS, CUMULATIVE G(T)	IS	.78
AT	20.750	HOURS, CUMULATIVE G(T)	IS	.81
AT	23.333	HOURS, CUMULATIVE G(T)	IS	.84

Fig. 32

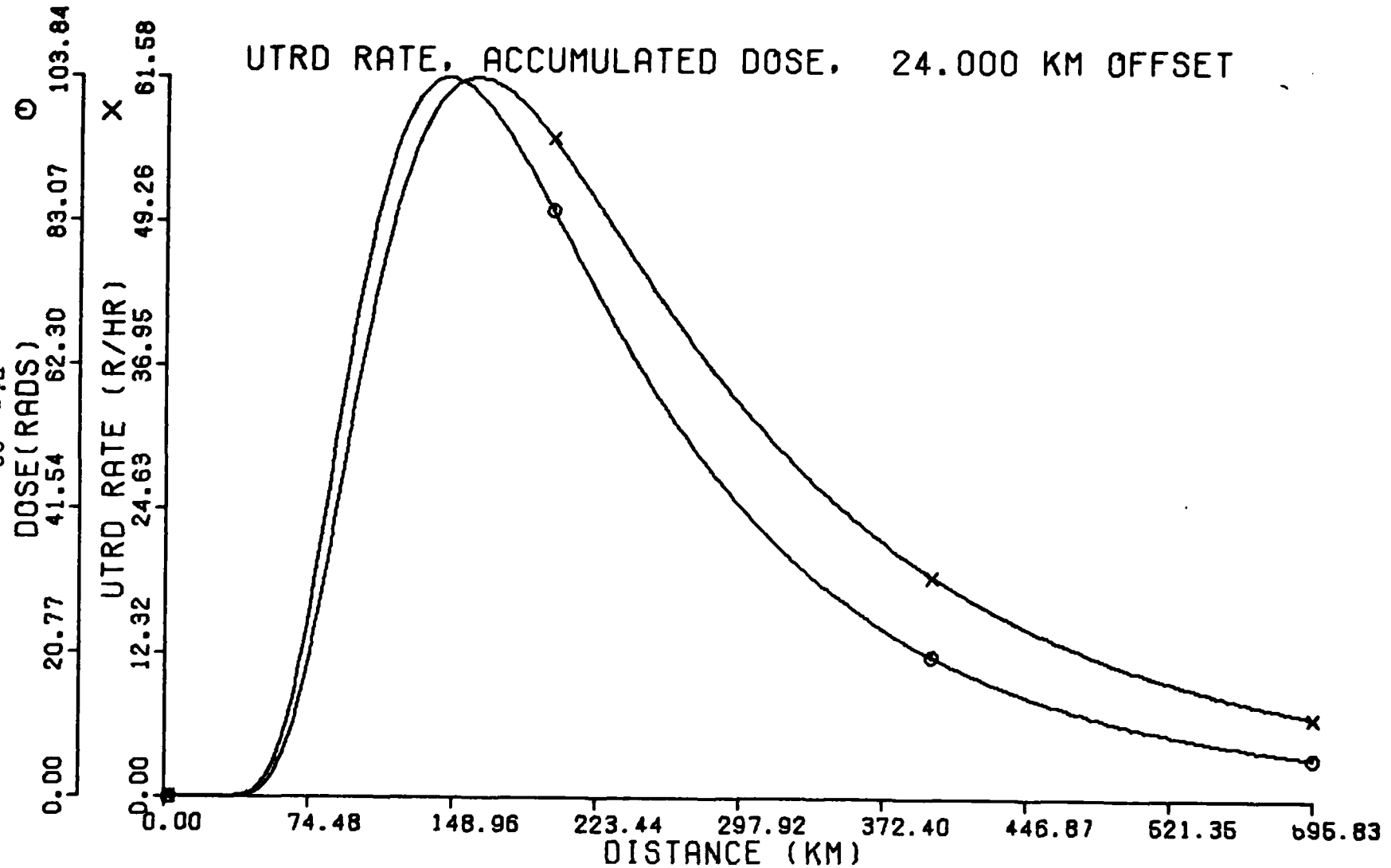

UTRD RATE, ACCUMULATED DOSE, 24.000 KM OFFSET
DOSE(RADS)
0.00
20.77
41.54
62.30
83.07
103.84
Θ
UTRD RATE (R/HR)
0.00
12.32
24.63
36.95
49.26
61.58
X
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. 33

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.64 KM

Y-OFFSET 30.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 37.772 RADS/HR, OCCURRED AT 197.92 KM

MAX ACCUM DOSE, 58.216 RADS, OCCURRED AT 181.25 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 34

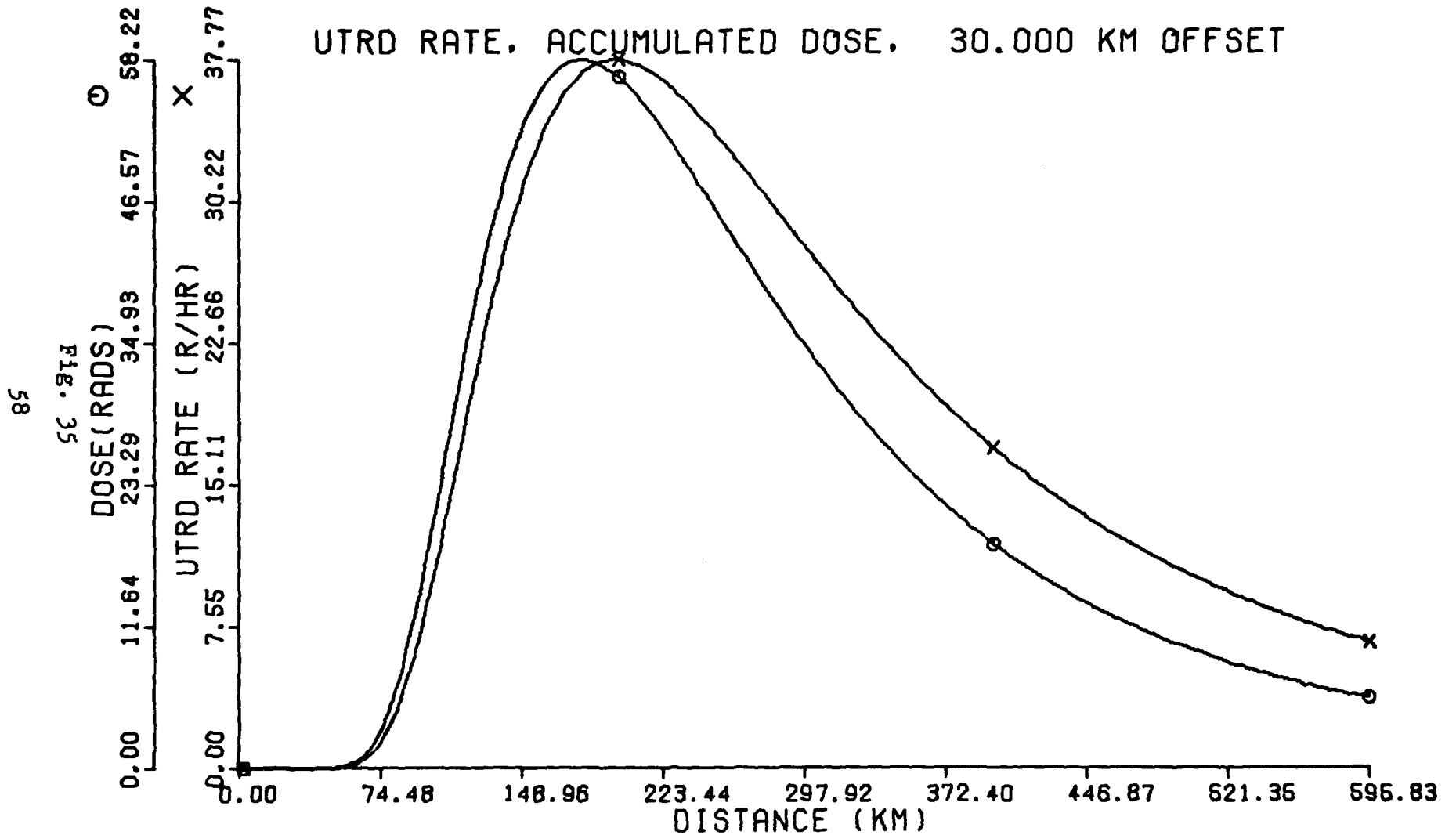

UTRD RATE, ACCUMULATED DOSE, 30.000 KM OFFSET
DOSE(RADS)
0.00
11.64
23.29
34.93
46.57
58.22
O
UTRD RATE (R/HR)
0.00
7.55
15.11
22.66
30.22
37.77
X
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

Fig. 35

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11590.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.04 KM

Y-OFFSET 36.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 24.769 RADS/HR, OCCURRED AT 235.42 KM

MAX ACCUM DOSE, 35.360 RADS, OCCURRED AT 214.58 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. 36

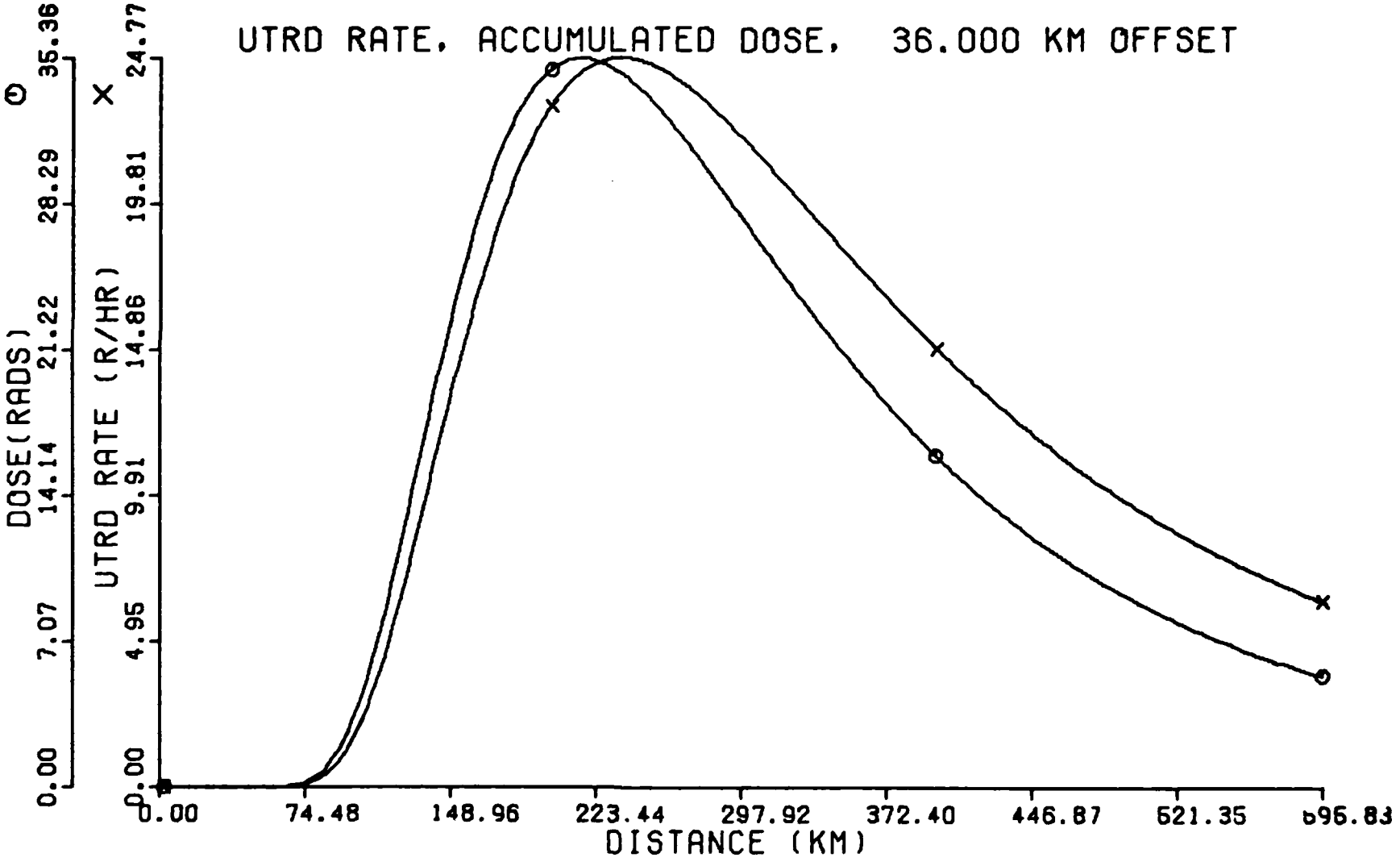

UTRD RATE, ACCUMULATED DOSE, 36.000 KM OFFSET
DOSE(RADS)
0.00
7.07
14.14
21.22
28.29
35.36
UTRD RATE (R/HR)
0.00
4.95
9.91
14.86
19.81
24.77
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

Fig. 37

VI Conclusions and Recommendations

This work presents a method for easily studying the character of fallout from a nuclear ground burst. The major output quantities from this method are: rate of fallout deposition (g(t)) and cumulative amount of fallout deposited as a function of time after cloud stabilization; and, unit-time reference dose rates and total dose accumulated to infinite time as a function of downwind distance from ground zero and crosswind offset from the cloud path. Validation of one g(t) run against an accepted standard is outlined briefly in Appendix D.

Various input parameters for the model presented may be varied, and their effects quickly studied. These parameters are: weapon yield; activity-size distribution, A(r); wind velocity and shear; and, fission fraction of weapon yield.

As Discussed in Chapter V, g(t) has been shown to be very sensitive to the particular A(r) chosen. Several (log-normal) distributions from the literature were chosen, and the effect of each particular choice examined. Results indicate the need for planners to carefully choose A(r) for a given case, and to be aware of the implications of this choice.

It has also been shown (in Chapter III) that a zero-thickness fallout cloud is an excellent approximation to a finite-thickness vertically distributed cloud possessing a symmetrical distribution of activity with altitude.

Recommendations

The present model, while providing ease of computation, does have shortcomings. The particle fall dynamics are well-described, and need no further work immediatly. An attempt should be made to include fractionation in the g(t) calculation, and results compared with DELFIC runs. Downwind shear should be added to the model. This will result in the necessity of carrying out an integration over the downwind extent of the cloud for each dose calculation instead of using equation(34) in its present form. Finally, and more completely, the entire method used in WSEG-RM-10 to describe cloud size and growth, adopted here essentially intact without criticism, should be examined for correctness in light of more recent work.

It is possible, using the table of polynomial coefficients provided and the calculation methods described, to develop a simple algorithm to enable a user to easily perform hand calculations of g(t) and dose quantities.

Possible far-future efforts might center around adopting the model presented herein, or a modified form of it, as a "subroutine" in a multi-burst analysis scheme, since the consideration of a single burst has little relevance to many conceivable tactical situations.

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2. Willis, Jay C. "The History of Fallout Prediction," Report: Wright-Patterson AFB, Ohio: Air Force Institute of Technology, 1979. (AD# pending)

3. Davies, C.N. "Definitive Equations for the Fluid Resistance of Spheres," The Proceedings of the Physical Society, Volume 57: London: 1945.

4. McDonald, James E. "An Aid to Computation of Terminal Fall Velocities of Spheres," Journal of Meterology: August 1960.

5. Russell, Irving. Critique of Land Fallout Models. Kirtland AFB, New Mexico: Air Force Weapons Laboratory, 1964 (AFWL-TR-65-76; Secret).

6. Schwenke, T.W., I. Kohlberg, H.G. Norment, and W.Y.G. Ing. Development of an Improved Land-Surface Fallout Model. Fort Monmouth, N.J.: U.S. Army Electronics Command, February, 1967. (ECOM-01309-F; AD 653633).

7. Ruotanen, Norman H. An Improvement to the WSEG Fallout Model Low Yield Prediction Capability. MS Thesis: Wright-Patterson AFB, Ohio: Air Force Institute of Technology, December, 1978.

8. Glasstone, Samuel and Philip J. Dolan, editors. The Effects of Nuclear Weapons. United States Department of Defense, United States Department of Energy, 1977.

9. Bridgman, C.J. Class Lecture 23 Aug. 1979. Wright-Patterson AFB, Ohio: Air Force Institute of Technology.

Although not directly referenced, the following provided essential guidance for Chapter I in particular and the entire work in general:

10. Bridgman, C.J. "A New Fallout Prediction Model for Use in Operational Type Studies." Unpublished draft. Wright-Patterson AFB, Ohio: Air Force Institute of Technology, 1979.

Appendix A

Particle Fall

This appendix contains the following exhibits:

- a listing of the CGEN code used to calculate particle fall polynomial coefficients
- a table of polynomial coefficients for each 200 meter altitude block from 200 meters to fifty kilometers above sea level
- plots of r vs t for various altitudes

CGEN Code

Figure A-1 is a listing of the CGEN code. The steps in the operation of the program are as follows:

1) Air density (RHO) and dynamic viscosity (MU) for each altitude block are read in.
2) Forty radii (R) in meters are calculated.
3) Q, Reynolds number (RE), and the reciprocal velocity (W) are calculated as detailed in Chapter II.
4) A numerical integration is performed to calculate a time of fall (T) in hours for each particle size from each altitude.
5) C_7 is calculated.
6) A least-squares fit is performed in subprogram PLSCF, fitting the function $y = r - C_7/\sqrt{t}$ to a polynomial in 1/t.
7) The resulting polynomial coefficients C_1

```
      PROGRAM CGEN(INPUT,PUNCH,OUTPUT)
      REAL MU(251)
      DIMENSION RHO(251),R(40),T(40,251),C(7,251),X(40),Y(40),CC(6),
     1WORK(50),WW(40)
      DO1I=1,251
1     READ 2,RHO(I),MU(I)
2     FORMAT(14X,2E14.5)
      DO3I=1,40
      WW(I)= 1.
      R(I)=5.E-06*I
      IF(I.GT.20)R(I)=1.E-04+7.5E-05*(I-20)
12    DO3J=1,251
      Q=272064.*RHO(J)*R(I)**3/MU(J)**2
      IF(Q.LT.120.)GOTO4
      QQ=ALOG10(Q)
      Z=-1.29536+.986*QQ-.046677*QQ**2+.0011235*QQ**3
      RE=10.**Z
      GOTO5
4     RE=Q/24.-2.3363E-04*Q*Q+2.0154E-06*Q**3-6.9105E-09*Q**4
5     W=RHO(J)/(RE*MU(J)*(1.+1.165E-07/(R(I)*RHO(J))))
      IF(J.EQ.1)GOTO6
      T(I,J)=T(I,J-1)+(WL+W)*.5*200.*2.*R(I)/3600.
      GOTO3
6     T(I,1)=0.
3     WL=W
      DO7I=2,251
      C(7,I)=5.E-06*SQRT(T(1,I))
      DO8J=1,40
      X(J)=1./T(J,I)
      Y(J)=R(J)-C(7,I)/SQRT(T(J,I))
8     CONTINUE
      CALL PLSCF(X,Y,WW,40,5,NMAX,CC,0,XD,XO,WORK,IER)
      IF(NMAX.NE.5)PRINT*," 1",I,NMAX
      IF(IER.NE.0)PRINT*," 2",I,IER
      DO7J=1,6
      C(J,I)=CC(7-J)
7     CONTINUE
      DO11J=2,251
11    PUNCH 10,(C(L,J),L=1,7)
10    FORMAT(7E11.5)
      STOP
      END
```

Fig A-1. CGEN Code

through C_6 are punched on cards.

Table of Coefficients

Table A-1 (five pages) is a list of the polynomial coefficients generated by the CGEN code. These coefficients may be substituted directly into (10) and (11). Then, entering a particular time, in hours, will yield a particular radius on the ground in meters or a rate of change of particle radius in meters per hours from the altitude and time considered. The choice of meters and hours as units was based on restrictions in the PLSCF subprogram on the limits of the numeric range over which it operates.

Plots of r vs. t

Figures A-2 and A-3 are, for purposes of illustration, plots of particle radius hitting the ground versus time for cloud center height corresponding to weapon yields in the 1 KT - 20 MT range. These plots were generated using the coefficients in Table A-1 and equation (10).

ALT	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)
200	-.42494E-15	.37874E-12	-.99764E-10	.23375E-07	.83123E-06	-.17840E-05	.13110E-04
400	-.13323E-13	.59598E-11	-.78875E-09	.92734E-07	.16550E-05	-.17823E-05	.18523E-04
600	-.99099E-13	.29668E-10	-.26305E-08	.20692E-06	.24713E-05	-.17806E-05	.22664E-04
800	-.40897E-12	.92185E-10	-.61605E-08	.36479E-06	.32801E-05	-.17789E-05	.26144E-04
1000	-.12220E-11	.22123E-09	-.11887E-07	.56516E-06	.40812E-05	-.17771E-05	.29202E-04
1200	-.29772E-11	.45092E-09	-.20291E-07	.80695E-06	.48748E-05	-.17754E-05	.31958E-04
1400	-.63023E-11	.82136E-09	-.31838E-07	.10892E-05	.56610E-05	-.17744E-05	.34484E-04
1600	-.12036E-10	.13778E-08	-.46963E-07	.14107E-05	.64397E-05	-.17740E-05	.36829E-04
1800	-.21240E-10	.21698E-08	-.66068E-07	.17705E-05	.72111E-05	-.17732E-05	.39024E-04
2000	-.35220E-10	.32509E-08	-.89534E-07	.21673E-05	.79750E-05	-.17721E-05	.41093E-04
2200	-.55534E-10	.46784E-08	-.11772E-06	.26002E-05	.87317E-05	-.17709E-05	.43055E-04
2400	-.84005E-10	.65129E-08	-.15098E-06	.30682E-05	.94814E-05	-.17695E-05	.44924E-04
2600	-.12271E-09	.88171E-08	-.18962E-06	.35702E-05	.10224E-04	-.17681E-05	.46711E-04
2800	-.17400E-09	.11656E-07	-.23394E-06	.41052E-05	.10959E-04	-.17664E-05	.48425E-04
3000	-.24045E-09	.15094E-07	-.28419E-06	.46722E-05	.11683E-04	-.17647E-05	.50073E-04
3200	-.32495E-09	.19202E-07	-.34063E-06	.52701E-05	.12409E-04	-.17630E-05	.51662E-04
3400	-.43064E-09	.24047E-07	-.40353E-06	.58983E-05	.13123E-04	-.17611E-05	.53196E-04
3600	-.56087E-09	.29700E-07	-.47308E-06	.65556E-05	.13831E-04	-.17592E-05	.54681E-04
3800	-.71923E-09	.36229E-07	-.54947E-06	.72411E-05	.14531E-04	-.17572E-05	.56121E-04
4000	-.90951E-09	.43702E-07	-.63288E-06	.79537E-05	.15225E-04	-.17552E-05	.57518E-04
4200	-.11352E-08	.52189E-07	-.72345E-06	.86927E-05	.15912E-04	-.17531E-05	.58875E-04
4400	-.14023E-08	.61762E-07	-.82138E-06	.94573E-05	.16593E-04	-.17510E-05	.60196E-04
4600	-.17135E-08	.72483E-07	-.92678E-06	.10247E-04	.17268E-04	-.17489E-05	.61483E-04
4800	-.20740E-08	.84430E-07	-.10398E-05	.11060E-04	.17934E-04	-.17467E-05	.62738E-04
5000	-.24884E-08	.97653E-07	-.11604E-05	.11895E-04	.18594E-04	-.17444E-05	.63962E-04
5200	-.29616E-08	.11222E-06	-.12887E-05	.12753E-04	.19248E-04	-.17422E-05	.65158E-04
5400	-.34938E-08	.12820E-06	-.14250E-05	.13632E-04	.19896E-04	-.17399E-05	.66327E-04
5600	-.41051E-08	.14566E-06	-.15691E-05	.14532E-04	.20537E-04	-.17375E-05	.67470E-04
5800	-.47859E-08	.16464E-06	-.17212E-05	.15452E-04	.21171E-04	-.17353E-05	.68588E-04
6000	-.55464E-08	.18522E-06	-.18814E-05	.16390E-04	.21798E-04	-.17331E-05	.69684E-04
6200	-.63918E-08	.20744E-06	-.20455E-05	.17347E-04	.22420E-04	-.17310E-05	.70757E-04
6400	-.73276E-08	.23135E-06	-.22256E-05	.18321E-04	.23035E-04	-.17287E-05	.71809E-04
6600	-.83591E-08	.25700E-06	-.24098E-05	.19312E-04	.23645E-04	-.17264E-05	.72840E-04
6800	-.94915E-08	.28444E-06	-.26018E-05	.20318E-04	.24248E-04	-.17241E-05	.73852E-04
7000	-.10730E-07	.31370E-06	-.28018E-05	.21340E-04	.24844E-04	-.17217E-05	.74845E-04
7200	-.12080E-07	.34482E-06	-.30096E-05	.22375E-04	.25435E-04	-.17192E-05	.75819E-04
7400	-.13547E-07	.37786E-06	-.32254E-05	.23425E-04	.26020E-04	-.17167E-05	.76777E-04
7600	-.15136E-07	.41285E-06	-.34489E-05	.24487E-04	.26600E-04	-.17141E-05	.77718E-04
7800	-.16852E-07	.44981E-06	-.36801E-05	.25562E-04	.27173E-04	-.17115E-05	.78642E-04
8000	-.18700E-07	.48876E-06	-.39189E-05	.26648E-04	.27741E-04	-.17088E-05	.79551E-04
8200	-.20685E-07	.52973E-06	-.41652E-05	.27745E-04	.28302E-04	-.17061E-05	.80445E-04
8400	-.22812E-07	.57277E-06	-.44190E-05	.28852E-04	.28859E-04	-.17034E-05	.81324E-04
8600	-.25035E-07	.61788E-06	-.46802E-05	.29970E-04	.29409E-04	-.17006E-05	.82189E-04
8800	-.27509E-07	.66508E-06	-.49486E-05	.31098E-04	.29955E-04	-.16977E-05	.83040E-04
9000	-.30037E-07	.71436E-06	-.52241E-05	.32238E-04	.30494E-04	-.16948E-05	.83878E-04
9200	-.32824E-07	.76576E-06	-.55068E-05	.33372E-04	.31028E-04	-.16918E-05	.84702E-04
9400	-.35727E-07	.81932E-06	-.57962E-05	.34522E-04	.31556E-04	-.16889E-05	.85514E-04
9600	-.38793E-07	.87504E-06	-.60928E-05	.35683E-04	.32079E-04	-.16859E-05	.86314E-04
9800	-.42040E-07	.93289E-06	-.63960E-05	.36843E-04	.32596E-04	-.16829E-05	.87102E-04
10000	-.45454E-07	.99285E-06	-.67056E-05	.38012E-04	.33108E-04	-.16799E-05	.87878E-04

Table A-1. Polynomial Coefficients

ALT	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)
10200	-.49044E-07	.10549E-05	-.70214E-05	.39185E-04	.33614E-04	-.16768E-05	.88642E-04
10400	-.52814E-07	.11191E-05	-.73434E-05	.40363E-04	.34116E-04	-.16736E-05	.89395E-04
10600	-.56767E-07	.11855E-05	-.76715E-05	.41544E-04	.34613E-04	-.16704E-05	.90137E-04
10800	-.60903E-07	.12539E-05	-.80053E-05	.42729E-04	.35105E-04	-.16672E-05	.90868E-04
11000	-.65224E-07	.13243E-05	-.83446E-05	.43916E-04	.35592E-04	-.16639E-05	.91589E-04
11200	-.69730E-07	.13968E-05	-.86892E-05	.45105E-04	.36074E-04	-.16604E-05	.92301E-04
11400	-.74421E-07	.14712E-05	-.90389E-05	.46294E-04	.36550E-04	-.16568E-05	.93006E-04
11600	-.79296E-07	.15476E-05	-.93934E-05	.47484E-04	.37020E-04	-.16530E-05	.93705E-04
11800	-.84357E-07	.16258E-05	-.97528E-05	.48674E-04	.37483E-04	-.16490E-05	.94397E-04
12000	-.89603E-07	.17059E-05	-.10117E-04	.49862E-04	.37941E-04	-.16449E-05	.95082E-04
12200	-.95031E-07	.17878E-05	-.10485E-04	.51049E-04	.38393E-04	-.16406E-05	.95761E-04
12400	-.10065E-06	.18715E-05	-.10857E-04	.52234E-04	.38840E-04	-.16361E-05	.96434E-04
12600	-.10644E-06	.19569E-05	-.11233E-04	.53417E-04	.39282E-04	-.16314E-05	.97101E-04
12800	-.11242E-06	.20439E-05	-.11612E-04	.54598E-04	.39719E-04	-.16266E-05	.97761E-04
13000	-.11858E-06	.21326E-05	-.11995E-04	.55774E-04	.40152E-04	-.16216E-05	.98416E-04
13200	-.12491E-06	.22229E-05	-.12381E-04	.56947E-04	.40578E-04	-.16164E-05	.99064E-04
13400	-.13144E-06	.23149E-05	-.12771E-04	.58119E-04	.41000E-04	-.16110E-05	.99707E-04
13600	-.13814E-06	.24084E-05	-.13164E-04	.59286E-04	.41418E-04	-.16055E-05	.10034E-03
13800	-.14501E-06	.25033E-05	-.13559E-04	.60449E-04	.41832E-04	-.15998E-05	.10097E-03
14000	-.15205E-06	.25996E-05	-.13956E-04	.61605E-04	.42242E-04	-.15939E-05	.10160E-03
14200	-.15926E-06	.26971E-05	-.14356E-04	.62756E-04	.42649E-04	-.15879E-05	.10222E-03
14400	-.16663E-06	.27961E-05	-.14757E-04	.63902E-04	.43052E-04	-.15817E-05	.10283E-03
14600	-.17418E-06	.28964E-05	-.15161E-04	.65044E-04	.43450E-04	-.15753E-05	.10344E-03
14800	-.18189E-06	.29980E-05	-.15567E-04	.66180E-04	.43845E-04	-.15688E-05	.10405E-03
15000	-.18975E-06	.31006E-05	-.15973E-04	.67309E-04	.44237E-04	-.15621E-05	.10464E-03
15200	-.19776E-06	.32043E-05	-.16381E-04	.68430E-04	.44626E-04	-.15552E-05	.10524E-03
15400	-.20593E-06	.33090E-05	-.16790E-04	.69545E-04	.45012E-04	-.15482E-05	.10582E-03
15600	-.21423E-06	.34147E-05	-.17200E-04	.70652E-04	.45398E-04	-.15410E-05	.10640E-03
15800	-.22269E-06	.35214E-05	-.17610E-04	.71753E-04	.45777E-04	-.15337E-05	.10698E-03
16000	-.23123E-06	.36290E-05	-.18021E-04	.72846E-04	.46155E-04	-.15261E-05	.10755E-03
16200	-.24001E-06	.37373E-05	-.18432E-04	.73930E-04	.46531E-04	-.15184E-05	.10812E-03
16400	-.24888E-06	.38464E-05	-.18843E-04	.75006E-04	.46900E-04	-.15106E-05	.10868E-03
16600	-.25783E-06	.39561E-05	-.19254E-04	.76072E-04	.47279E-04	-.15027E-05	.10924E-03
16800	-.26692E-06	.40664E-05	-.19663E-04	.77129E-04	.47651E-04	-.14946E-05	.10979E-03
17000	-.27611E-06	.41772E-05	-.20072E-04	.78177E-04	.48021E-04	-.14863E-05	.11033E-03
17200	-.28543E-06	.42886E-05	-.20481E-04	.79217E-04	.48388E-04	-.14778E-05	.11087E-03
17400	-.29484E-06	.44004E-05	-.20889E-04	.80246E-04	.48756E-04	-.14692E-05	.11141E-03
17600	-.30435E-06	.45125E-05	-.21295E-04	.81265E-04	.49122E-04	-.14604E-05	.11194E-03
17800	-.31392E-06	.46248E-05	-.21698E-04	.82273E-04	.49489E-04	-.14516E-05	.11246E-03
18000	-.32361E-06	.47374E-05	-.22101E-04	.83270E-04	.49855E-04	-.14425E-05	.11298E-03
18200	-.33332E-06	.48501E-05	-.22502E-04	.84258E-04	.50219E-04	-.14332E-05	.11350E-03
18400	-.34319E-06	.49630E-05	-.22903E-04	.85234E-04	.50584E-04	-.14239E-05	.11401E-03
18600	-.35308E-06	.50758E-05	-.23296E-04	.86199E-04	.50949E-04	-.14144E-05	.11451E-03
18800	-.36302E-06	.51885E-05	-.23689E-04	.87151E-04	.51316E-04	-.14048E-05	.11501E-03
19000	-.37301E-06	.53010E-05	-.24079E-04	.88091E-04	.51682E-04	-.13950E-05	.11551E-03
19200	-.38305E-06	.54134E-05	-.24467E-04	.89020E-04	.52048E-04	-.13851E-05	.11600E-03
19400	-.39313E-06	.55256E-05	-.24851E-04	.89937E-04	.52415E-04	-.13750E-05	.11649E-03
19600	-.40323E-06	.56373E-05	-.25231E-04	.90840E-04	.52784E-04	-.13649E-05	.11697E-03
19800	-.41334E-06	.57484E-05	-.25607E-04	.91729E-04	.53155E-04	-.13546E-05	.11744E-03
20000	-.42347E-06	.58590E-05	-.25973E-04	.92605E-04	.53527E-04	-.13442E-05	.11791E-03

Table A-1. (Continued)

ALT	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)
20200	-.43361E-06	.59692E-05	-.26347E-04	.93468E-04	.53900E-04	-.13335E-05	.11839E-03
20400	-.44374E-06	.60786E-05	-.26710E-04	.94317E-04	.54276E-04	-.13228E-05	.11884E-03
20600	-.45385E-06	.61871E-05	-.27068E-04	.95150E-04	.54655E-04	-.13120E-05	.11930E-03
20800	-.46391E-06	.62945E-05	-.27420E-04	.95967E-04	.55037E-04	-.13011E-05	.11975E-03
21000	-.47392E-06	.64007E-05	-.27765E-04	.96766E-04	.55423E-04	-.12901E-05	.12020E-03
21200	-.48387E-06	.65057E-05	-.28104E-04	.97549E-04	.55812E-04	-.12790E-05	.12064E-03
21400	-.49377E-06	.66095E-05	-.28437E-04	.98317E-04	.56206E-04	-.12679E-05	.12108E-03
21600	-.50362E-06	.67121E-05	-.28763E-04	.99068E-04	.56603E-04	-.12566E-05	.12151E-03
21800	-.51338E-06	.68133E-05	-.29083E-04	.99802E-04	.57003E-04	-.12452E-05	.12194E-03
22000	-.52306E-06	.69131E-05	-.29396E-04	.10052E-03	.57408E-04	-.12337E-05	.12237E-03
22200	-.53265E-06	.70113E-05	-.29701E-04	.10122E-03	.57817E-04	-.12220E-05	.12278E-03
22400	-.54217E-06	.71083E-05	-.30001E-04	.10190E-03	.58229E-04	-.12103E-05	.12320E-03
22600	-.55159E-06	.72038E-05	-.30293E-04	.10257E-03	.58646E-04	-.11984E-05	.12361E-03
22800	-.56091E-06	.72977E-05	-.30579E-04	.10323E-03	.59066E-04	-.11863E-05	.12401E-03
23000	-.57012E-06	.73900E-05	-.30857E-04	.10388E-03	.59490E-04	-.11741E-05	.12442E-03
23200	-.57922E-06	.74806E-05	-.31128E-04	.10448E-03	.59919E-04	-.11618E-05	.12481E-03
23400	-.58822E-06	.75697E-05	-.31393E-04	.10508E-03	.60351E-04	-.11493E-05	.12520E-03
23600	-.59710E-06	.76573E-05	-.31651E-04	.10567E-03	.60787E-04	-.11366E-05	.12559E-03
23800	-.60586E-06	.77431E-05	-.31901E-04	.10625E-03	.61227E-04	-.11238E-05	.12597E-03
24000	-.61448E-06	.78271E-05	-.32144E-04	.10680E-03	.61671E-04	-.11108E-05	.12635E-03
24200	-.62297E-06	.79093E-05	-.32379E-04	.10734E-03	.62119E-04	-.10976E-05	.12672E-03
24400	-.63134E-06	.79895E-05	-.32608E-04	.10786E-03	.62571E-04	-.10843E-05	.12709E-03
24600	-.63956E-06	.80687E-05	-.32829E-04	.10837E-03	.63027E-04	-.10708E-05	.12745E-03
24800	-.64764E-06	.81456E-05	-.33043E-04	.10887E-03	.63487E-04	-.10572E-05	.12781E-03
25000	-.65556E-06	.82205E-05	-.33249E-04	.10934E-03	.63951E-04	-.10433E-05	.12816E-03
25200	-.66333E-06	.82936E-05	-.33447E-04	.10981E-03	.64420E-04	-.10293E-05	.12851E-03
25400	-.67094E-06	.83648E-05	-.33639E-04	.11025E-03	.64893E-04	-.10151E-05	.12885E-03
25600	-.67840E-06	.84341E-05	-.33823E-04	.11068E-03	.65370E-04	-.10008E-05	.12919E-03
25800	-.68569E-06	.85014E-05	-.33999E-04	.11110E-03	.65852E-04	-.98627E-06	.12952E-03
26000	-.69279E-06	.85665E-05	-.34167E-04	.11150E-03	.66338E-04	-.97158E-06	.12985E-03
26200	-.69972E-06	.86296E-05	-.34327E-04	.11189E-03	.66829E-04	-.95672E-06	.13018E-03
26400	-.70648E-06	.86907E-05	-.34479E-04	.11225E-03	.67324E-04	-.94173E-06	.13050E-03
26600	-.71306E-06	.87498E-05	-.34624E-04	.11260E-03	.67823E-04	-.92658E-06	.13081E-03
26800	-.71944E-06	.88066E-05	-.34761E-04	.11294E-03	.68328E-04	-.91128E-06	.13112E-03
27000	-.72562E-06	.88612E-05	-.34890E-04	.11326E-03	.68837E-04	-.89583E-06	.13143E-03
27200	-.73160E-06	.89136E-05	-.35010E-04	.11356E-03	.69351E-04	-.88023E-06	.13173E-03
27400	-.73740E-06	.89639E-05	-.35123E-04	.11385E-03	.69869E-04	-.86450E-06	.13202E-03
27600	-.74299E-06	.90120E-05	-.35227E-04	.11413E-03	.70392E-04	-.84864E-06	.13232E-03
27800	-.74836E-06	.90578E-05	-.35324E-04	.11439E-03	.70920E-04	-.83264E-06	.13260E-03
28000	-.75352E-06	.91012E-05	-.35411E-04	.11463E-03	.71453E-04	-.81651E-06	.13289E-03
28200	-.75845E-06	.91423E-05	-.35491E-04	.11486E-03	.71991E-04	-.80026E-06	.13316E-03
28400	-.76318E-06	.91811E-05	-.35562E-04	.11507E-03	.72534E-04	-.78391E-06	.13344E-03
28600	-.76769E-06	.92177E-05	-.35626E-04	.11527E-03	.73081E-04	-.76745E-06	.13371E-03
28800	-.77197E-06	.92518E-05	-.35681E-04	.11545E-03	.73634E-04	-.75090E-06	.13397E-03
29000	-.77601E-06	.92835E-05	-.35727E-04	.11562E-03	.74191E-04	-.73423E-06	.13423E-03
29200	-.77982E-06	.93127E-05	-.35764E-04	.11577E-03	.74754E-04	-.71748E-06	.13449E-03
29400	-.78340E-06	.93397E-05	-.35794E-04	.11590E-03	.75321E-04	-.70066E-06	.13474E-03
29600	-.78676E-06	.93643E-05	-.35816E-04	.11602E-03	.75893E-04	-.68376E-06	.13498E-03
29800	-.78987E-06	.93864E-05	-.35829E-04	.11613E-03	.76470E-04	-.66679E-06	.13523E-03
30000	-.79273E-06	.94060E-05	-.35833E-04	.11622E-03	.77051E-04	-.64975E-06	.13546E-03

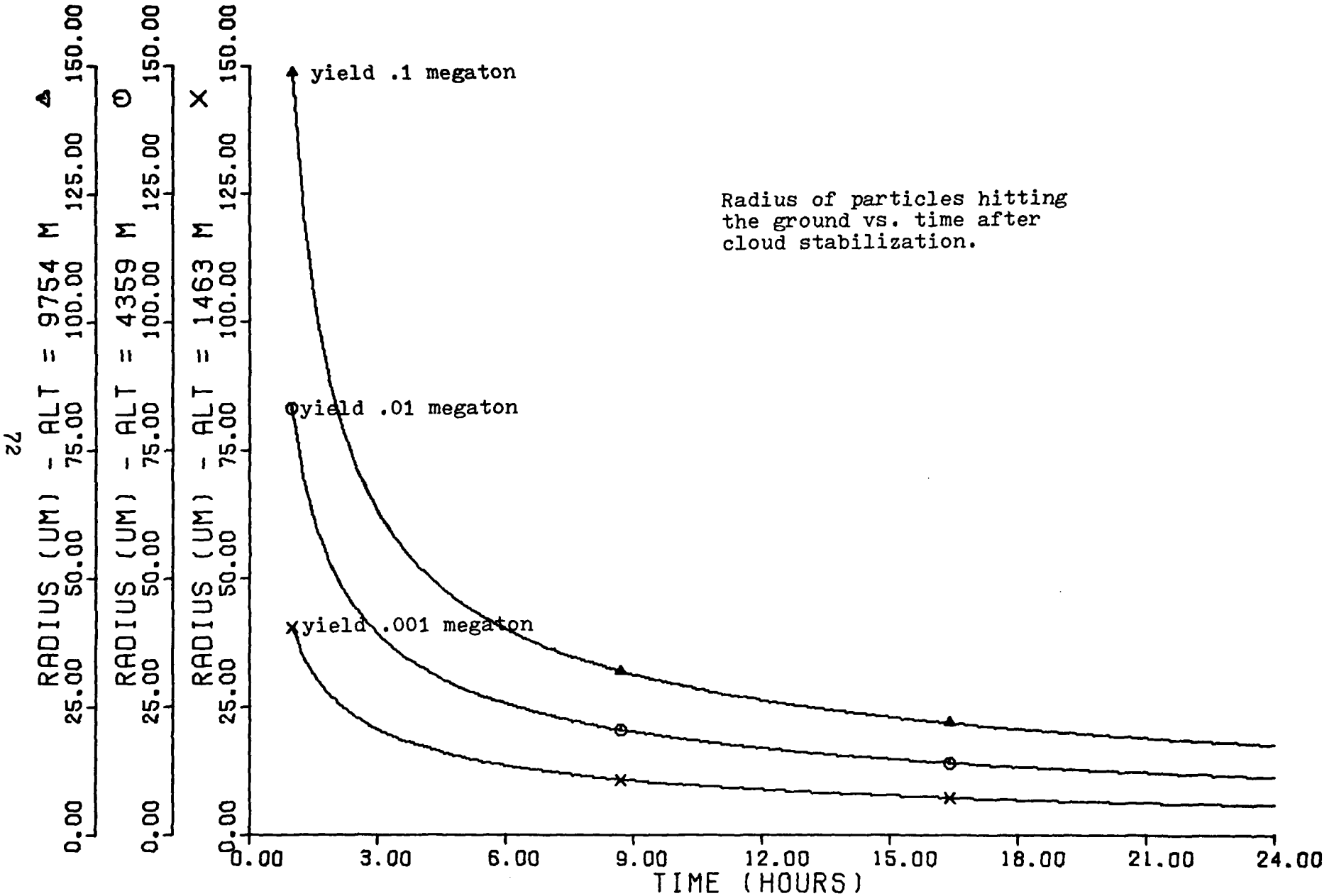
Table A-1. (Continued)

ALT	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)
30200	-.79537E-06	.94235E-05	-.35831E-04	.11630E-03	.77636E-04	-.63250E-06	.13570E-03
30400	-.79781E-06	.94390E-05	-.35822E-04	.11637E-03	.78223E-04	-.61506E-06	.13593E-03
30600	-.80000E-06	.94520E-05	-.35805E-04	.11642E-03	.78815E-04	-.59760E-06	.13615E-03
30800	-.80194E-06	.94624E-05	-.35779E-04	.11646E-03	.79412E-04	-.58015E-06	.13637E-03
31000	-.80360E-06	.94701E-05	-.35743E-04	.11648E-03	.80016E-04	-.56273E-06	.13659E-03
31200	-.80500E-06	.94752E-05	-.35699E-04	.11649E-03	.80625E-04	-.54536E-06	.13680E-03
31400	-.80615E-06	.94778E-05	-.35646E-04	.11648E-03	.81239E-04	-.52805E-06	.13701E-03
31600	-.80704E-06	.94779E-05	-.35584E-04	.11645E-03	.81859E-04	-.51081E-06	.13722E-03
31800	-.80766E-06	.94752E-05	-.35513E-04	.11641E-03	.82485E-04	-.49365E-06	.13742E-03
32000	-.80800E-06	.94699E-05	-.35433E-04	.11636E-03	.83116E-04	-.47658E-06	.13761E-03
32200	-.80806E-06	.94618E-05	-.35344E-04	.11629E-03	.83753E-04	-.45960E-06	.13781E-03
32400	-.80784E-06	.94510E-05	-.35246E-04	.11620E-03	.84397E-04	-.44269E-06	.13800E-03
32600	-.80734E-06	.94374E-05	-.35138E-04	.11610E-03	.85046E-04	-.42588E-06	.13818E-03
32800	-.80653E-06	.94209E-05	-.35020E-04	.11598E-03	.85702E-04	-.40915E-06	.13836E-03
33000	-.80543E-06	.94015E-05	-.34893E-04	.11584E-03	.86364E-04	-.39252E-06	.13854E-03
33200	-.80404E-06	.93793E-05	-.34757E-04	.11569E-03	.87031E-04	-.37599E-06	.13872E-03
33400	-.80236E-06	.93545E-05	-.34611E-04	.11552E-03	.87705E-04	-.35956E-06	.13889E-03
33600	-.80040E-06	.93269E-05	-.34457E-04	.11534E-03	.88383E-04	-.34322E-06	.13905E-03
33800	-.79816E-06	.92966E-05	-.34294E-04	.11514E-03	.89068E-04	-.32699E-06	.13922E-03
34000	-.79562E-06	.92636E-05	-.34122E-04	.11493E-03	.89757E-04	-.31087E-06	.13938E-03
34200	-.79279E-06	.92279E-05	-.33941E-04	.11471E-03	.90452E-04	-.29485E-06	.13954E-03
34400	-.78970E-06	.91897E-05	-.33752E-04	.11447E-03	.91151E-04	-.27895E-06	.13969E-03
34600	-.78634E-06	.91490E-05	-.33555E-04	.11422E-03	.91855E-04	-.26316E-06	.13984E-03
34800	-.78271E-06	.91057E-05	-.33350E-04	.11395E-03	.92563E-04	-.24749E-06	.13999E-03
35000	-.77880E-06	.90600E-05	-.33137E-04	.11367E-03	.93275E-04	-.23195E-06	.14013E-03
35200	-.77463E-06	.90118E-05	-.32916E-04	.11338E-03	.93992E-04	-.21654E-06	.14027E-03
35400	-.77021E-06	.89613E-05	-.32688E-04	.11308E-03	.94712E-04	-.20125E-06	.14041E-03
35600	-.76555E-06	.89086E-05	-.32454E-04	.11277E-03	.95435E-04	-.18611E-06	.14055E-03
35800	-.76065E-06	.88537E-05	-.32212E-04	.11245E-03	.96162E-04	-.17110E-06	.14068E-03
36000	-.75546E-06	.87965E-05	-.31963E-04	.11211E-03	.96892E-04	-.15625E-06	.14081E-03
36200	-.75006E-06	.87371E-05	-.31707E-04	.11177E-03	.97625E-04	-.14155E-06	.14093E-03
36400	-.74442E-06	.86757E-05	-.31445E-04	.11141E-03	.98361E-04	-.12699E-06	.14106E-03
36600	-.73852E-06	.86120E-05	-.31177E-04	.11104E-03	.99098E-04	-.11248E-06	.14118E-03
36800	-.73236E-06	.85462E-05	-.30903E-04	.11067E-03	.99836E-04	-.98035E-07	.14130E-03
37000	-.72590E-06	.84784E-05	-.30623E-04	.11029E-03	.10058E-03	-.83804E-07	.14141E-03
37200	-.71942E-06	.84088E-05	-.30337E-04	.10989E-03	.10132E-03	-.69791E-07	.14153E-03
37400	-.71267E-06	.83376E-05	-.30046E-04	.10949E-03	.10207E-03	-.55995E-07	.14164E-03
37600	-.70573E-06	.82648E-05	-.29750E-04	.10909E-03	.10281E-03	-.42435E-07	.14174E-03
37800	-.69862E-06	.81905E-05	-.29449E-04	.10867E-03	.10355E-03	-.29125E-07	.14185E-03
38000	-.69133E-06	.81148E-05	-.29144E-04	.10824E-03	.10432E-03	-.16081E-07	.14195E-03
38200	-.68388E-06	.80372E-05	-.28834E-04	.10781E-03	.10507E-03	-.32943E-08	.14205E-03
38400	-.67627E-06	.79584E-05	-.28520E-04	.10737E-03	.10583E-03	.92451E-08	.14215E-03
38600	-.66851E-06	.78783E-05	-.28202E-04	.10692E-03	.10658E-03	.21527E-07	.14225E-03
38800	-.66060E-06	.77968E-05	-.27879E-04	.10647E-03	.10734E-03	.33541E-07	.14234E-03
39000	-.65254E-06	.77141E-05	-.27553E-04	.10601E-03	.10810E-03	.45276E-07	.14243E-03
39200	-.64434E-06	.76302E-05	-.27223E-04	.10554E-03	.10887E-03	.56745E-07	.14252E-03
39400	-.63600E-06	.75451E-05	-.26890E-04	.10507E-03	.10963E-03	.67961E-07	.14261E-03
39600	-.62754E-06	.74589E-05	-.26554E-04	.10459E-03	.11039E-03	.78915E-07	.14269E-03
39800	-.61895E-06	.73717E-05	-.26215E-04	.10411E-03	.11115E-03	.89600E-07	.14278E-03
40000	-.61024E-06	.72835E-05	-.25873E-04	.10362E-03	.11192E-03	.10001E-06	.14286E-03

Table A-1. (Continued)

ALT	C(1)	C(2)	C(3)	C(4)	C(5)	C(6)	C(7)
40200	-.60142E-06	.71944E-05	-.25529E-04	.10313E-03	.11268E-03	.11015E-06	.14294E-03
40400	-.59249E-06	.71043E-05	-.25182E-04	.10263E-03	.11344E-03	.12004E-06	.14302E-03
40600	-.58346E-06	.70135E-05	-.24833E-04	.10213E-03	.11420E-03	.12967E-06	.14309E-03
40800	-.57433E-06	.69218E-05	-.24482E-04	.10163E-03	.11496E-03	.13904E-06	.14317E-03
41000	-.56510E-06	.68294E-05	-.24129E-04	.10113E-03	.11572E-03	.14813E-06	.14324E-03
41200	-.55579E-06	.67364E-05	-.23775E-04	.10062E-03	.11648E-03	.15696E-06	.14331E-03
41400	-.54628E-06	.66418E-05	-.23417E-04	.10011E-03	.11724E-03	.16559E-06	.14338E-03
41600	-.53659E-06	.65458E-05	-.23055E-04	.99589E-04	.11800E-03	.17398E-06	.14345E-03
41800	-.52687E-06	.64496E-05	-.22693E-04	.99071E-04	.11875E-03	.18211E-06	.14351E-03
42000	-.51714E-06	.63533E-05	-.22332E-04	.98553E-04	.11950E-03	.18996E-06	.14358E-03
42200	-.50739E-06	.62571E-05	-.21970E-04	.98035E-04	.12025E-03	.19755E-06	.14364E-03
42400	-.49765E-06	.61610E-05	-.21610E-04	.97517E-04	.12100E-03	.20488E-06	.14370E-03
42600	-.48791E-06	.60650E-05	-.21250E-04	.97000E-04	.12175E-03	.21195E-06	.14376E-03
42800	-.47820E-06	.59693E-05	-.20892E-04	.96483E-04	.12249E-03	.21876E-06	.14382E-03
43000	-.46853E-06	.58740E-05	-.20535E-04	.95968E-04	.12323E-03	.22528E-06	.14387E-03
43200	-.45889E-06	.57791E-05	-.20180E-04	.95454E-04	.12397E-03	.23155E-06	.14393E-03
43400	-.44927E-06	.56845E-05	-.19826E-04	.94942E-04	.12470E-03	.23757E-06	.14398E-03
43600	-.43970E-06	.55904E-05	-.19474E-04	.94431E-04	.12544E-03	.24334E-06	.14404E-03
43800	-.43017E-06	.54968E-05	-.19124E-04	.93923E-04	.12616E-03	.24885E-06	.14409E-03
44000	-.42070E-06	.54038E-05	-.18776E-04	.93416E-04	.12689E-03	.25409E-06	.14414E-03
44200	-.41128E-06	.53112E-05	-.18431E-04	.92913E-04	.12761E-03	.25909E-06	.14419E-03
44400	-.40191E-06	.52192E-05	-.18087E-04	.92411E-04	.12833E-03	.26385E-06	.14424E-03
44600	-.39259E-06	.51278E-05	-.17746E-04	.91912E-04	.12904E-03	.26837E-06	.14428E-03
44800	-.38332E-06	.50370E-05	-.17406E-04	.91417E-04	.12975E-03	.27265E-06	.14433E-03
45000	-.37413E-06	.49468E-05	-.17070E-04	.90924E-04	.13046E-03	.27668E-06	.14437E-03
45200	-.36483E-06	.48559E-05	-.16732E-04	.90431E-04	.13116E-03	.28044E-06	.14442E-03
45400	-.35544E-06	.47644E-05	-.16393E-04	.89936E-04	.13186E-03	.28395E-06	.14446E-03
45600	-.34614E-06	.46737E-05	-.16057E-04	.89446E-04	.13256E-03	.28725E-06	.14450E-03
45800	-.33696E-06	.45842E-05	-.15726E-04	.88961E-04	.13325E-03	.29033E-06	.14454E-03
46000	-.32791E-06	.44960E-05	-.15398E-04	.88482E-04	.13393E-03	.29320E-06	.14458E-03
46200	-.31901E-06	.44092E-05	-.15076E-04	.88006E-04	.13461E-03	.29587E-06	.14462E-03
46400	-.31025E-06	.43237E-05	-.14758E-04	.87541E-04	.13529E-03	.29836E-06	.14466E-03
46600	-.30164E-06	.42396E-05	-.14444E-04	.87079E-04	.13596E-03	.30066E-06	.14470E-03
46800	-.29320E-06	.41570E-05	-.14136E-04	.86624E-04	.13662E-03	.30278E-06	.14473E-03
47000	-.28493E-06	.40760E-05	-.13833E-04	.86176E-04	.13728E-03	.30471E-06	.14477E-03
47200	-.27683E-06	.39966E-05	-.13536E-04	.85735E-04	.13793E-03	.30646E-06	.14480E-03
47400	-.26887E-06	.39186E-05	-.13244E-04	.85300E-04	.13858E-03	.30806E-06	.14484E-03
47600	-.26103E-06	.38421E-05	-.12956E-04	.84872E-04	.13922E-03	.30949E-06	.14487E-03
47800	-.25345E-06	.37672E-05	-.12674E-04	.84452E-04	.13985E-03	.31077E-06	.14490E-03
48000	-.24600E-06	.36939E-05	-.12398E-04	.84038E-04	.14048E-03	.31189E-06	.14493E-03
48200	-.23870E-06	.36221E-05	-.12127E-04	.83632E-04	.14110E-03	.31288E-06	.14496E-03
48400	-.23156E-06	.35517E-05	-.11860E-04	.83233E-04	.14171E-03	.31369E-06	.14499E-03
48600	-.22457E-06	.34828E-05	-.11599E-04	.82841E-04	.14232E-03	.31438E-06	.14502E-03
48800	-.21759E-06	.34140E-05	-.11339E-04	.82452E-04	.14292E-03	.31486E-06	.14505E-03
49000	-.21082E-06	.33455E-05	-.11082E-04	.82065E-04	.14352E-03	.31514E-06	.14508E-03
49200	-.20383E-06	.32786E-05	-.10827E-04	.81686E-04	.14411E-03	.31529E-06	.14510E-03
49400	-.19722E-06	.32133E-05	-.10580E-04	.81315E-04	.14470E-03	.31534E-06	.14513E-03
49600	-.19078E-06	.31498E-05	-.10338E-04	.80952E-04	.14527E-03	.31528E-06	.14516E-03
49800	-.18455E-06	.30881E-05	-.10103E-04	.80598E-04	.14584E-03	.31512E-06	.14518E-03
50000	-.17852E-06	.30283E-05	-.98739E-05	.80252E-04	.14641E-03	.31486E-06	.14521E-03

Table A-1. (Continued)



Radius of particles hitting the ground vs. time after cloud stabilization.

Fig. A-2

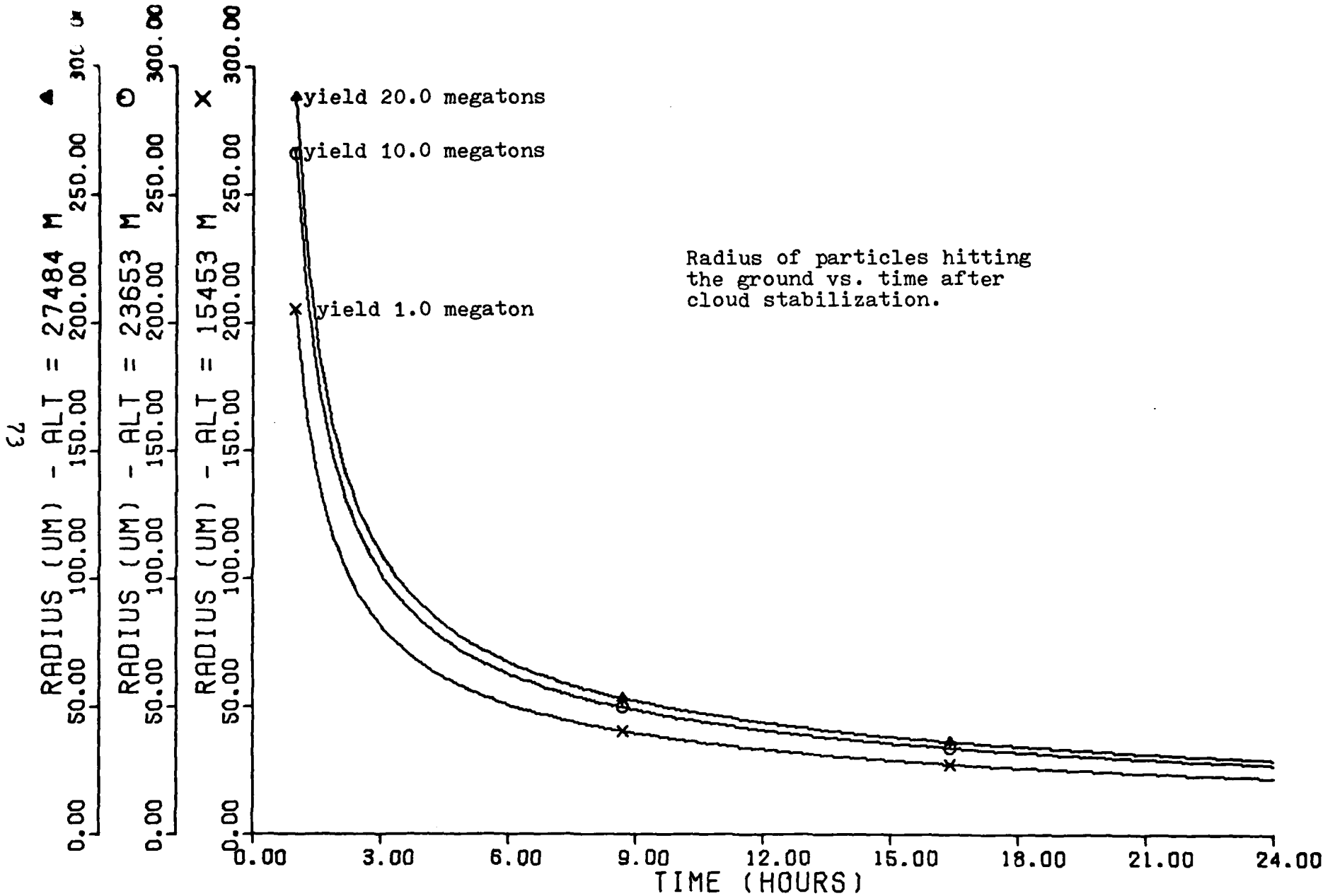

yield 20.0 megatons
yield 10.0 megatons
yield 1.0 megaton
Radius of particles hitting the ground vs. time after cloud stabilization.
RADIUS (UM) - ALT = 27484 M
RADIUS (UM) - ALT = 23653 M
RADIUS (UM) - ALT = 15453 M
0.00
50.00
100.00
150.00
200.00
250.00
300.00
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. A-3

Appendix B - Fortran Code for Calculation of g(t) and Dose Quantities

This Appendix contains the following items:

- a copy of the FALL code that calculates and displays g(t) and dose information (Fig. B-1, four pages)
- a user's guide to running the compiled version of the FALL program
- a sample of output from FALL and an explanation of how to interpret the output.

FALL Code

The FALL code reads in as basic data the table of coefficients in Table A-1. For each fallout problem the user must prepare a data card with the parameters of the problem he is interested in.

The operation of FALL is straightforward, all quantities being calculated as described in Chapters II and III. FALL then supplies a printed output of the problem parameters and selected calculated quantities, and, at the user's option, plots of g(t), UTRD rate, and accumulated dose.

User's Guide to FALL

Figure B-2 is a sample deck used to run the complied version of FALL on the CYBER system. It is necessary to request CM70000 to insure enough memory to load all necessary elements. If several data sets are run in one program

```
      PROGRAMFALL(INPUT,OUTPUT,PLOT,TAPE5,TAPE8,OUT)
      DIMENSION G(866),GG(866),TIME(866),C(7,250),D(866),
     1DIST(866),U(866),CC(7)
      P=2.5066283
      REWIND 5
      DO1I=1,250
1     READ(5,3)(C(J,I),J=1,7)
3     FORMAT(7E11.5)
30    READ*,Y,TF,A,B,V,YYY,SY,II,FF
      IF(EOF(5LINPUT).NE.0.)GOTO999
      U1=0.
      U2=0.
      U3=0.
      U4=0.
      UD1=0.
      UD2=0.
      UD3=0.
      UD4=0.
      IF(TF.EQ.0.)TF=24.
      D1=0.
      D2=0.
      D3=0.
      DIST1=0.
      DIST2=0.
      DIST3=0.
      IF(A.EQ.0.)A=44.6
      IF(B.EQ.0.)B=.69
      IF(V.EQ.0.)V=25.
      IF(SY.EQ.0.)SY=1.2
      IF(II.GT.3)II=0
      IF(II.LT.0)II=0
      IF(FF.EQ.0.)FF=.5
      YY=ALOG10(Y)
      AK=.9-.4*YY+.3*YY*YY+.1*YY**3
      HO=304.8*(50.7+20.4*YY+3.5*YY**2+2.4*YY**3+.6*YY**4)
      YY=ALOG(Y)
      SIGRAD=EXP(.7+YY/3.-3.25/(4.+(YY+5.4)**2))*1.609344
      SIGRAD=SIGRAD*AK
      SIGZ=1.25E-04*HO
      TT=HO/1524.-2.5*(HO/18288.)**2
      ELZERO=V*TT
      EL=SQRT(ELZERO**2+2.*SIGRAD**2)
      TI=HO*8.1E-06+3.23E-03
      I=IFIX(TI*12.)
      TI=I/12.
      J=IFIX((TF-TI)*12.)
      A=ALOG(A)
      G(1)=0.
      GG(1)=0.
      TIME(1)=TI
      DIST(1)=V*TIME(1)
      U(1)=0.
      D(1)=0.
      GMAX=0.
      UMAX=0.
      DMAX=0.
      DO10I=2,J
      TIME(I)=TIME(I-1)+1./12.
      T=TIME(I)
      L=HO/200.
      H=HO/200.-L
      DO31K=1,7
31    CC(K)=H*C(K,L+1)+(1.-H)*C(K,L)
```

Fig. B-1. FALL CODE

```
      R=CC(1)/T**5+CC(2)/T**4+CC(3)/T**3+CC(4)/T**2+CC(5)/T
     1+CC(6)+CC(7)/SQRT(T)
      R=R*1000000.
      AR=(1./(P*B*R))*EXP(((ALOG(R)-A)/B)**2)/(-2.))
      DRDT=-5.*CC(1)/T**6-4.*CC(2)/T**5-3.*CC(3)/T**4-2.*CC(4)/
     1T**3-CC(5)/T**2-CC(7)/(2.*T**1.5)
      DRDT=DRDT*1000000./3600.*(-1.)
      G(I)=AR*DRDT
      DIST(I)=V*TIME(I)
      GG(I)=GG(I-1)+(G(I)+G(I-1))*150.
      SIGY=SQRT(SIGRAD**2*(1.+8.*DIST(I)/EL)+(DIST(I)*SY*SIGZ/V)**2)
      U(I)=9.29E+09*Y*FF*G(I)*EXP(-.5*(YYY/SIGY)**2)/(V*SIGY)
      D(I)=U(I)*5.*(TIME(I)**(-.2)-.3588708)
      UMAX=AMAX1(U(I),UMAX)
      DMAX=AMAX1(DMAX,D(I))
10    GMAX=AMAX1(G(I),GMAX)
      GMAX=GMAX*3600.
      DO220I=1,J
220   G(I)=G(I)*3600.
      DO11I=2,J
      IF(U(I-1).LT.U(I))DU=DIST(I)
      IF(U(I-1).LT.U(I))KI=I
      IF(D(I-1).LT.D(I))DD=DIST(I)
      IF(D(I-1).LT.D(I))KK=I
11    IF(G(I-1).LT.G(I))TG=TIME(I)
      DO12I=KK,J
      IF(D(I).LE.1000.)D1=D(I)
      IF(D(I).LE.1000.)DIST1=DIST(I)
12    IF(D(I).LE.1000.)GOTO13
13    DO14K=I,J
      IF(D(K).LE.500.)D2=D(K)
      IF(D(K).LE.500.)DIST2=DIST(K)
14    IF(D(K).LE.500.)GOTO15
15    DO16I=K,J
      IF(D(I).LE.100.)D3=D(I)
      IF(D(I).LE.100.)DIST3=DIST(I)
16    IF(D(I).LE.100.)GOTO17
17    DO21I=KI,J
      IF(U(I).LE.3000.)U1=U(I)
      IF(U(I).LE.3000.)UD1=DIST(I)
21    IF(U(I).LE.3000.)GOTO22
22    DO23K=I,J
      IF(U(K).LE.1000.)U2=U(K)
      IF(U(K).LE.1000.)UD2=DIST(K)
23    IF(U(K).LE.1000.)GOTO24
24    DO35I=K,J
      IF(U(I).LE.300.)U3=U(I)
      IF(U(I).LE.300.)UD3=DIST(I)
35    IF(U(I).LE.300.)GOTO26
26    DO27K=I,J
      IF(U(K).LE.100.)U4=U(K)
      IF(U(K).LE.100.)UD4=DIST(K)
27    IF(U(K).LE.100.)GOTO28
28    G(J+2)=GMAX/5.
      GG(J+2)=.2
      TIME(J+2)=TF/8.0
      DIST(J+2)=DIST(J)/8.
      G(J+1)=0.
      GG(J+1)=0.
      TIME(J+1)=0.
      DIST(J+1)=0.
      U(J+1)=0.
```

Fig. B-1. (Continued)

```
      U(J+2)=UMAX/5.
      D(J+1)=0.
      D(J+2)=DMAX/5.
      A=EXP(A)
      SIGZ=6000.*SIGZ
      PRINT 99
99    FORMAT("1"//)
      PRINT 201,Y
201   FORMAT(11X," YIELD ",F8.3," MEGATONS")
      PRINT 202,FF
202   FORMAT(/,11X," FISSION FRACTION ",F5.2)
      PRINT 203,TI
203   FORMAT(/,11X," INITIAL TIME ",F6.3," HOURS")
      PRINT 204,TF
204   FORMAT(/,11X," FINAL TIME ",F7.3," HOURS")
      PRINT 205,HO
205   FORMAT(/,11X," CLOUD CENTER HEIGHT ",F7.1," METERS")
      PRINT 206,SIGZ
206   FORMAT(/,11X," 3-SIGMA CLOUD THICKNESS ",F7.1," METERS")
      PRINT 207,SIGRAD
207   FORMAT(/,11X," INITIAL HORIZONTAL CLOUD RADIUS ",F6.2," KM")
      PRINT 208,YYY
208   FORMAT(/,11X," Y-OFFSET ",F6.2," KM")
      PRINT 209,V
209   FORMAT(/,11X," WIND VELOCITY ",F7.2," KM/HR")
      PRINT 210,SY
210   FORMAT(/,11X," WIND SHEAR ",F6.2," KM/HR PER KM OF CLOUD THICKNE
     1")
      PRINT 211,A,B
211   FORMAT(/,11X," A(R) PARAMETERS:  MEAN ",F7.2," MICRONS, SLOPE ",
     1F5.2)
      PRINT 212,GMAX,TG
212   FORMAT(/,11X," MAX G(T), ",E12.5," PER HR, OCCURRED AT ",F7.3,
     1" HOURS")
      PRINT 213,UMAX,DU
213   FORMAT(/,11X," MAX UTRD RATE, ",F10.3," RADS/HR, OCCURRED AT ",
     1F8.2," KM")
      PRINT 214,DMAX,DD
214   FORMAT(/,11X," MAX ACCUM DOSE, ",F10.3," RADS, OCCURRED AT "
     1,F8.2," KM")
215   FORMAT(/,11X," ACCUMULATED DOSE OF ",F10.3," RADS OCCURRED AT",
     1F8.2," KM")
216   FORMAT(/,11X," UTRD RATE OF ",F10.3," RADS/HR OCCURRED AT ",
     1F8.2," KM")
      IF(D1.EQ.DMAX.OR.D1.EQ.0.)GOTO41
      PRINT 215,D1,DIST1
41    IF(D2.EQ.DMAX.OR.D2.EQ.0.)GOTO42
      PRINT 215,D2,DIST2
42    IF(D3.EQ.DMAX.OR.D3.EQ.0.)GOTO43
      PRINT 215,D3,DIST3
43    IF(U1.EQ.UMAX.OR.U1.EQ.0.)GOTO44
      PRINT 216,U1,UD1
44    IF(U2.EQ.UMAX.OR.U2.EQ.0.)GOTO45
      PRINT 216,U2,UD2
45    IF(U3.EQ.UMAX.OR.U3.EQ.0.)GOTO46
      PRINT 216,U3,UD3
46    IF(U4.EQ.UMAX.OR.U4.EQ.0.)GOTO47
      PRINT 216,U4,UD4
      PRINT*," "
47    PRINT*," "
      PRINT*,"              SELECTED CUMULATIVE G(T) DATA:"
      PRINT*," "
```

Fig. B-1. (Continued)

```
      JJ=J/9
      DO25I=1,J,JJ
25    PRINT 217,TIME(I),GG(I)
217   FORMAT(12X,"AT ",F7.3," HOURS, CUMULATIVE G(T) IS ",F6.2)
      PRINT 99
      IF(II.EQ.0)GOTO30
      IF(II.NE.2)PRINT*,"G(T) PLOT REQUESTED"
      IF(II.NE.1)PRINT*,"DOSE PLOT REQUESTED"
      CALL DRAWIN(5LTAPE8)
      CALLDRAWOUT(3LOUT)
      REWIND 8
      IF(II.EQ.2)GOTO20
      A1=3H5.0
      A2=3H8.0
      A3=3H.15
      A4=2H50
      A5=10HG(T), CUM
      A6=5HG(T),
      A7=10H MEGATON,
      A8=5H UM,
      WRITE(8,105)A1,A2,A3,A4,A5,A6,Y,A7,A,A8,B
105   FORMAT(3(2X,A3),3X,A2,4X,A10,A5,F7.3,A10,F7.2,A5,F6.3)
      A1=2H12
      A2=4HTIME
      A3=7H(HOURS)
      A4=2H08
      A5=8HCUM G(T)
      A6=2H12
      A7=4HG(T)
      A8=7HPER HR
      WRITE(8,101)A1,A2,A3,A4,A5,A6,A7,A8
101   FORMAT(A2,2X,A4,1X,A7,/,A2,2X,A8,/,A2,2X,A4,1X,A7)
20    A1=3H5.0
      A2=3H8.0
      A3=3H.15
      A4=2H46
      A5=10HUTRD RATE,
      A6=9H ACCUMULA
      A7=9HTED DOSE,
      A8=10H KM OFFSET
      WRITE(8,102)A1,A2,A3,A4,A5,A6,A7,YYY,A8
102   FORMAT(3(2X,A3)3X,A2,4X,A10,2A9,F8.3,A10)
      A1=2H13
      A2=8HDISTANCE
      A3=4H(KM)
      A4=2H10
      A5=10HDOSE(RADS)
      A6=2H16
      A7=9HUTRD RATE
      A8=6H(R/HR)
      WRITE(8,103)A1,A2,A3,A4,A5,A6,A7,A8
103   FORMAT(A2,2X,A8,1X,A4,/,A2,2X,A10,/,A2,2X,A9,1X,A6)
      REWIND 8
      IF(II.NE.2)CALLDRAW2(TIME,G,GG,G,G,-2.0,J,1,1)
      IF(II.NE.1)CALLDRAW2(DIST,U,D,D,D,-2,0,J,1,1)
      GOTO30
999   STOP
      END
```

Fig. B-1. (Continued)

Card	Note
RFC,CM70000.TXXXXXX	Use appropriate ID #
ATTACH,A,AFITSUBROUTINES,ID=AFIT.	
LIBRARY,A.	
ATTACH,TAPE5,DATA,ID=T790432.	
ATTACH,LGO,FALL,CY=5,ID=T790432.	
LGO.	
7/8/9	
1,0,0,0,0,0,0,0,0	Data Card
.	" "
.	" "
.	" "
.	" "
.01,72,37.3,1.45,50,10,2.4,3,.8	" "
7/8/9	
6/7/8/9	

Fig B-2. Sample deck for FALL

run, It may be necessary to request additional CP time on the job card.

Each data card represents a separate fallout problem. Data is entered in free-field format, i.e.

READ*,Y,TF,A,B,V,YYY,SY,II,FF.

Variables should be assigned values as follows:

Y- weapon yield in megatons.

TF- final time for calculations, in hours. A zero value will set TF to 24 hours.

A- mean particle radius for activity-size distribution, microns. A zero value will set A to 44.6 microns.

B- logarithmic slope of A(r). A zero value will set B to .69.

V- Wind velocity, KM/HR. A zero value will set V to 25 KM/HR

YYY- Crosswind offset in KM for dose calculations. Plots of dose quantities are made parallel to the effective wind at user-selected offsets from the "hotline". Several plots at various offsets can be used to construct dose rate and accumulated dose contours.

SY- Vertical wind shear in cloud, KM/HR per KM of cloud thickness. A zero value sets SY to 1.2.

II- Output selector. The following outputs will be generated for the indicated values of II:

II	OUTPUT
0	Printout only
1	Printout and g(t), cumulative g(t) plots
2	Printout and dose plots
3	Printout and all plots

FF- fission fraction of the device. A zero value will set FF to .5.

Interpretation of Output from FALL

Figures B-3, B-4, and B-5 are the output from a run of FALL that requested both g(t) and dose plots for analysis of a one megaton burst with all other parameters set to default values. The data card for this run would look like

1,0,0,0,0,0,0,3,0

Referring to figure B-3, the output starts by repeating the yield and fission fraction selected. The initial time for all calculations is calculated by the program, and is approximately the time it would take a one centimeter particle to fall from the cloud center height. Final time is as specified in the input card. Three initial cloud parameters as calculated by the program are then listed. The y offset, wind parameters, and A(r) specifications are as input.

The program then prints the maximum g(t), the time at which it occurred, and the maximum UTRD rate and accumulated dose and the distances from ground zero at which

YIELD 1.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .083 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 15453.4 METERS

3-SIGMA CLOUD THICKNESS 11593.1 METERS

INITIAL HORIZONTAL CLOUD RADIUS 2.74 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .98357E-01 PER HR, OCCURRED AT 2.417 HOURS

MAX UTRD RATE, 794.869 RADS/HR, OCCURRED AT 41.67 KM

MAX ACCUM DOSE, 2213.379 RADS, OCCURRED AT 35.42 KM

ACCUMULATED DOSE OF 988.127 RADS OCCURRED AT 87.50 KM

ACCUMULATED DOSE OF 491.397 RADS OCCURRED AT 127.08 KM

ACCUMULATED DOSE OF 98.705 RADS OCCURRED AT 247.92 KM

UTRD RATE OF 293.952 RADS/HR OCCURRED AT 120.83 KM

UTRD RATE OF 99.089 RADS/HR OCCURRED AT 214.58 KM

SELECTED CUMULATIVE G(T) DATA

AT	.083	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.16
AT	5.250	HOURS, CUMULATIVE G(T) IS	.37
AT	7.833	HOURS, CUMULATIVE G(T) IS	.52
AT	10.417	HOURS, CUMULATIVE G(T) IS	.62
AT	13.000	HOURS, CUMULATIVE G(T) IS	.69
AT	15.583	HOURS, CUMULATIVE G(T) IS	.74
AT	18.167	HOURS, CUMULATIVE G(T) IS	.78
AT	20.750	HOURS, CUMULATIVE G(T) IS	.81
AT	23.333	HOURS, CUMULATIVE G(T) IS	.84

Fig. B-3. Sample Printed Output

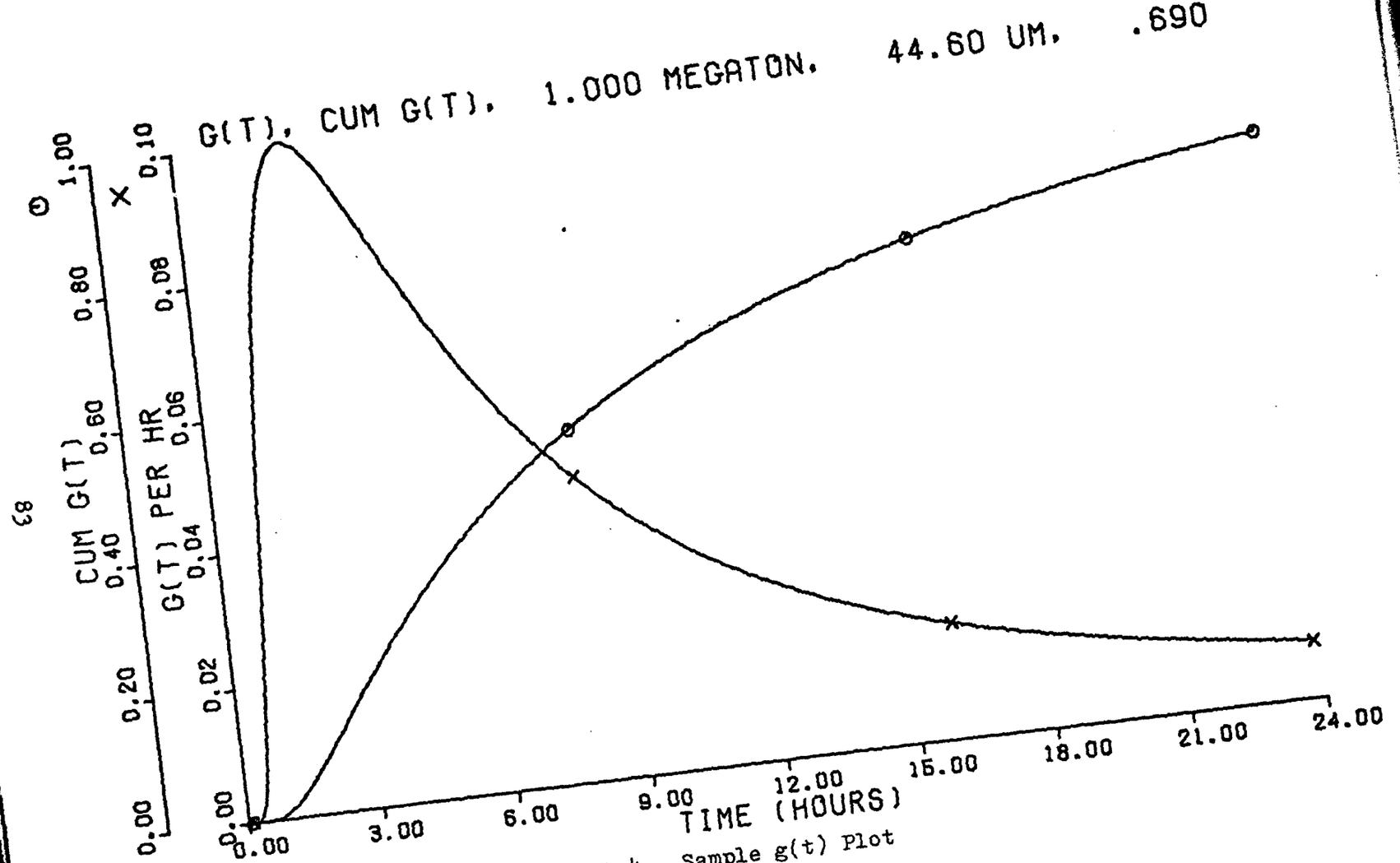


Fig. B-4. Sample g(t) Plot

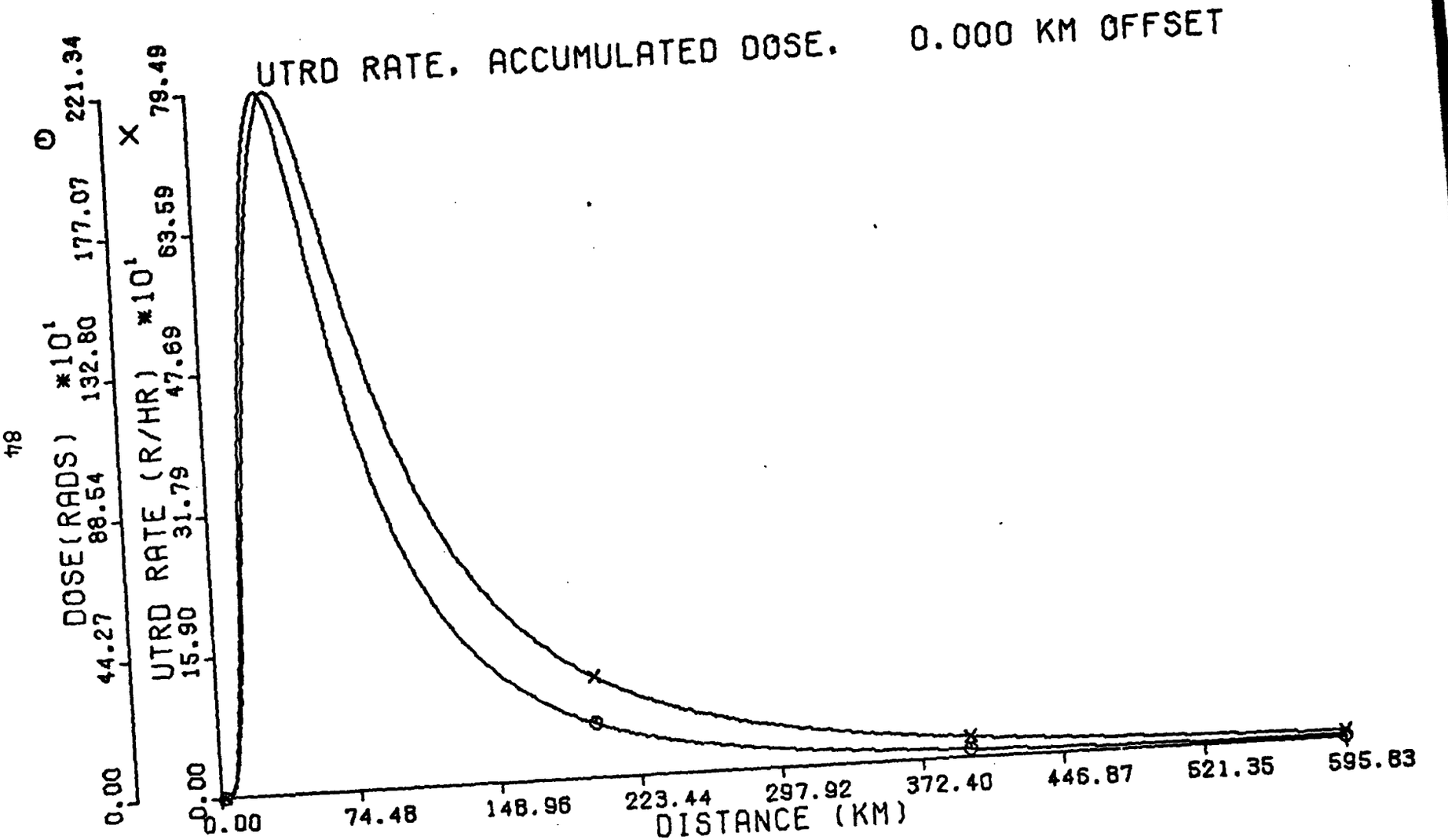


Fig. B-5. Sample Dose Plots

they occurred. These distances are along a line parallel to the path of the cloud offset by the y offset value. The simplified geometry chosen will lead to symmetry about the straight line cloud path.

The program will select several doses and UTRD rates and list them, along with the distances at which they occured. These values will be: for dose, the highest values that do not exceed 1000, 500, and 100 rads; for UTRD rate, the highest values that do not exceed 3000, 1000, 300, and 100 rads/ hr. If any of these values are also the previously-listed maximum values, they will not be repeated. Values closer to the origin than the maximum values are not listed.

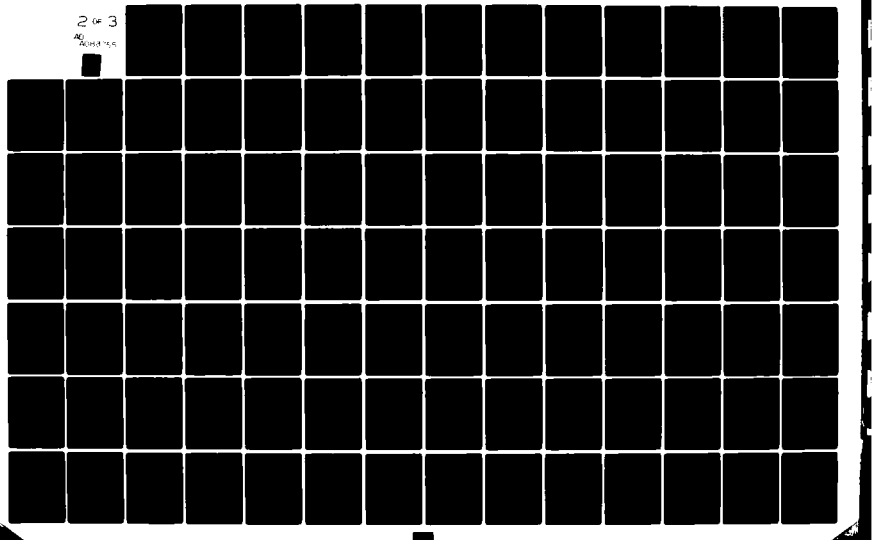
Cumulative g(t) information is listed for ten points over the range of time selected. This enables the user to quickly see how much of the radioactivity is down at any particular time after cloud stabilization.

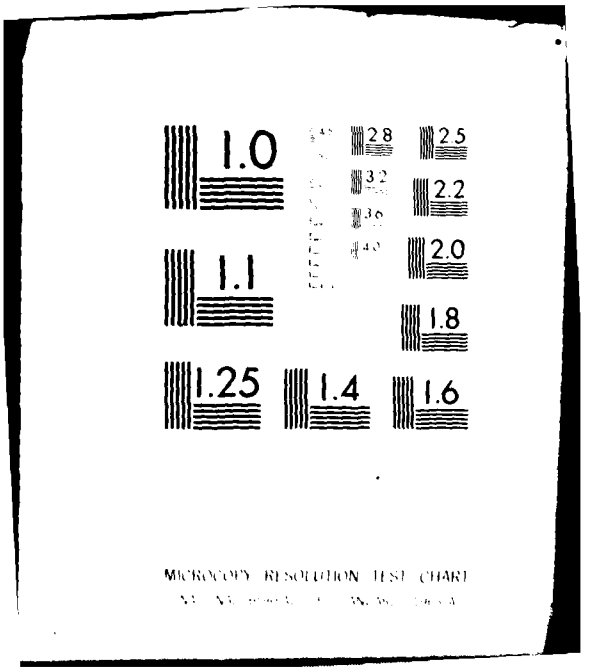
It is suggested that one or more runs of the program be made requesting only the printed output before any plots are requested for a given problem. Computer resources may thus be conserved, and the user will be able to better decide how to specify his problem before generating plots.

Interpretation of the output plots is straightforward. The horizontal axis of the g(t) plot, time, and that of the dose plot, distance, are related by input wind velocity. Care should be taken that the correct line is examined on either plot by observing the marginal symbols associated with each quantity. The user should also be

careful to consider any power-of-ten multiplier printed near the axis label.

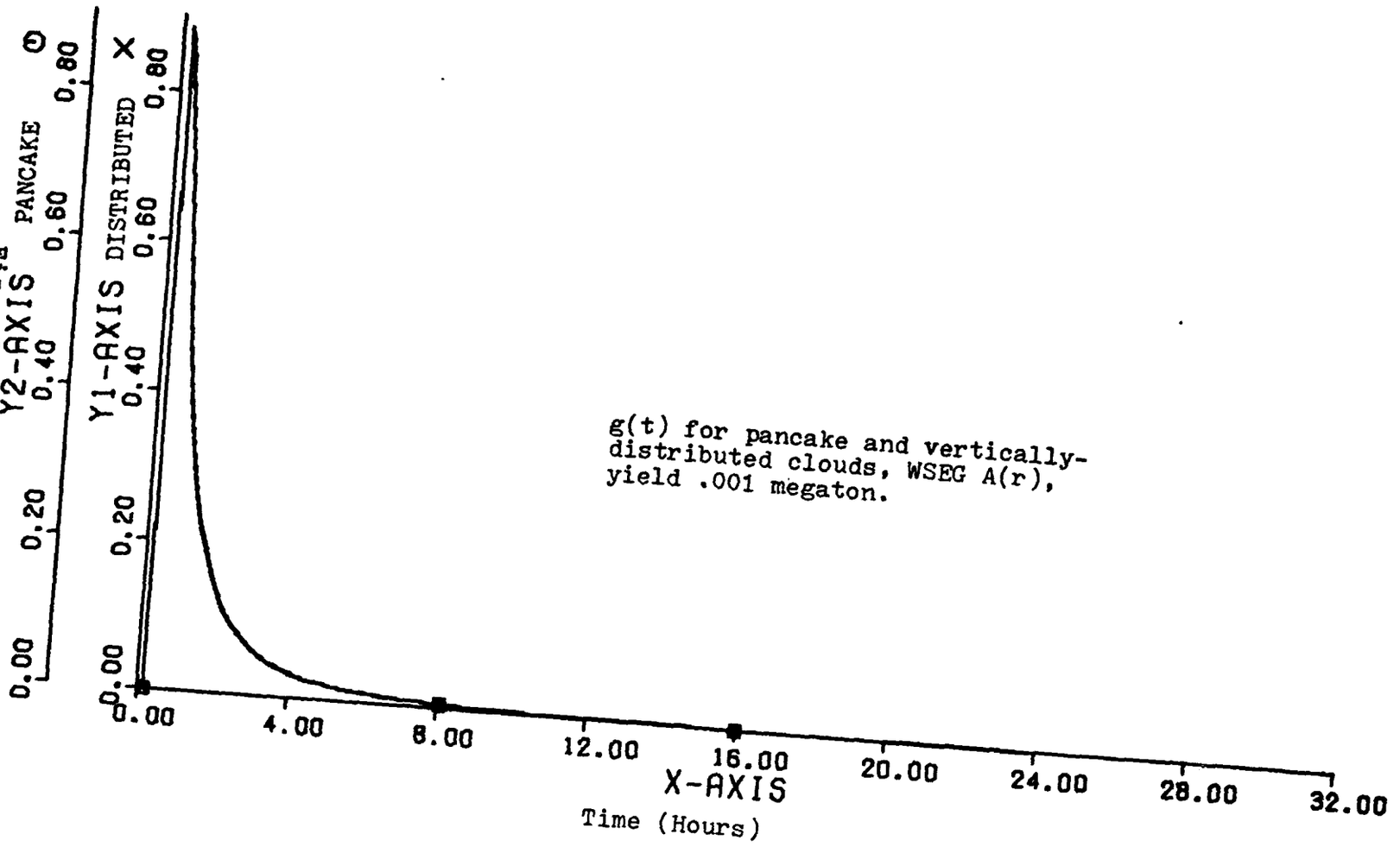
AD-A083 755 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOO--ETC F/G 18/8
A COMPUTER FALLOUT MODEL FOR OPERATIONAL TYPE STUDIES.(U)
MAR 80 R F COLARCO
UNCLASSIFIED AFIT/GST/PH/80M-1 NL




1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART

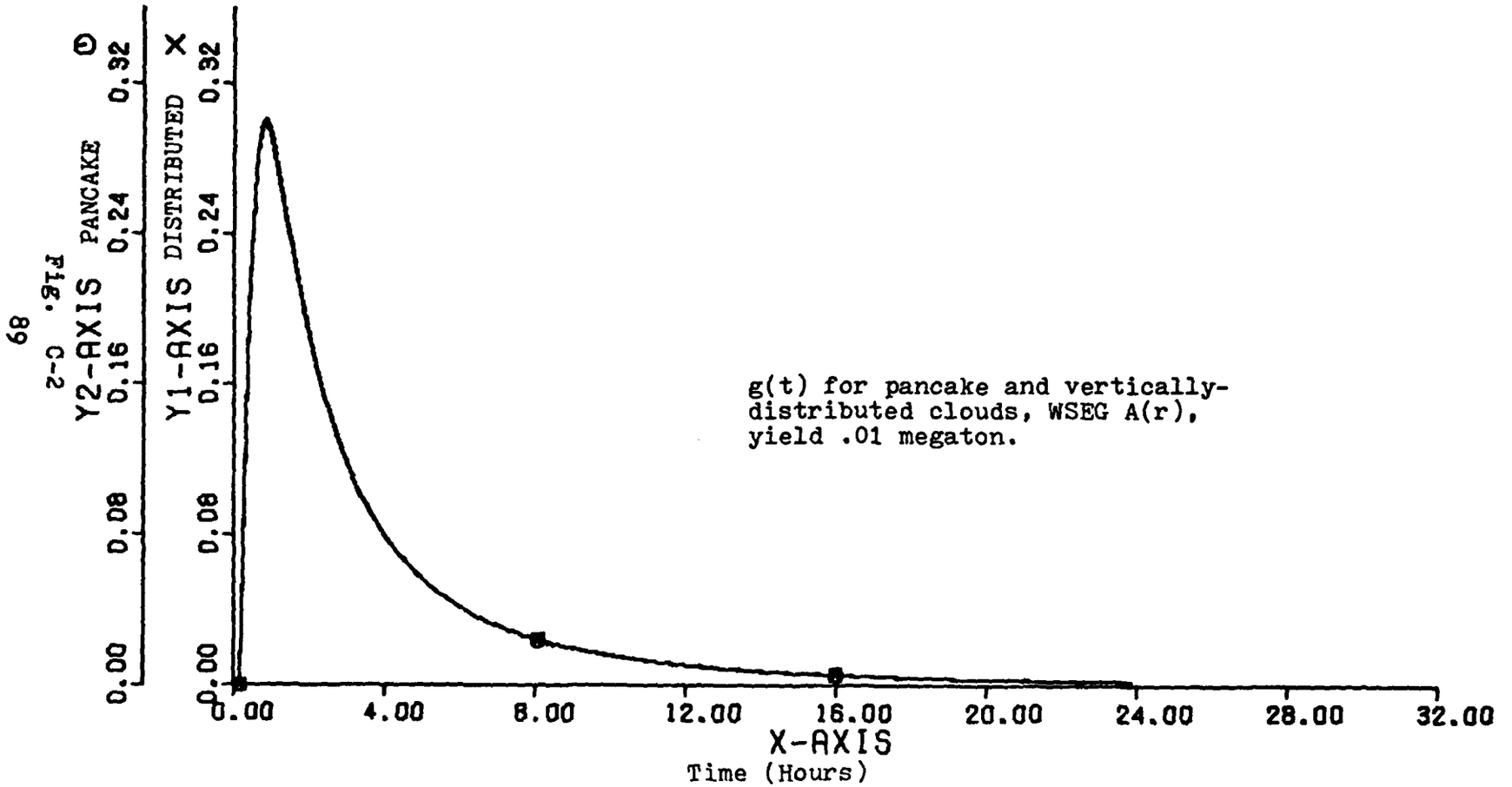
Appendix C Comparison of Pancake and Distributed g(t) Plots

Figures C-1 through C-5 are plots of g(t) for distributed and pancake clouds at yields of 1, 10, and 100 KT, and 10 and 20 MT. It can be seen in all cases that a pancake cloud geometry approximates the distributed cloud very closely, with this approximation getting better as weapon yield increases. Using the pancake approximation has the dual advantage of reducing computer time for analysis of a given problem by about three-fourths and allowing selected g(t) calculations to be made by hand.



g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield .001 megaton.

Fig. C-1



g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield .01 megaton.

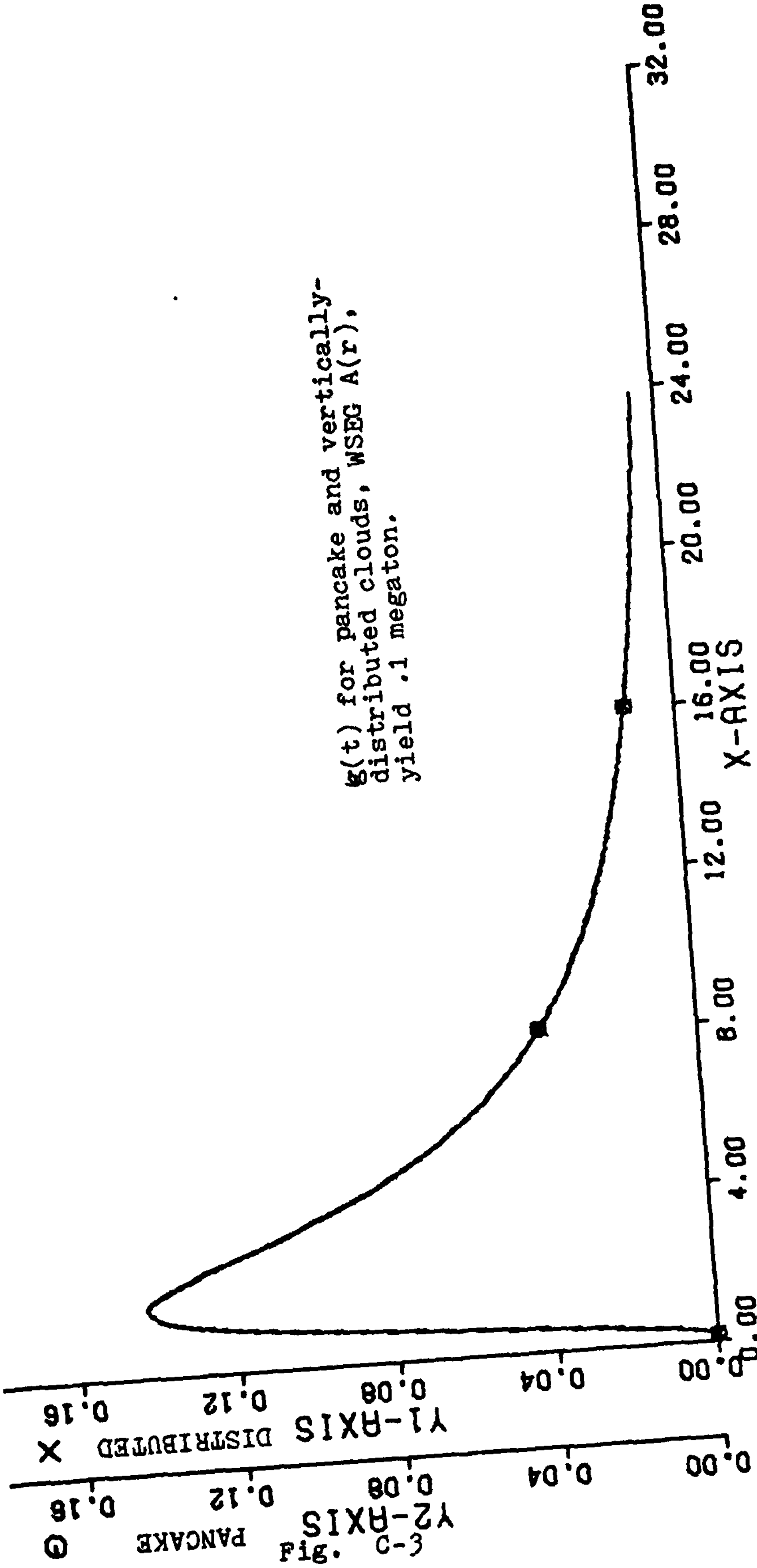
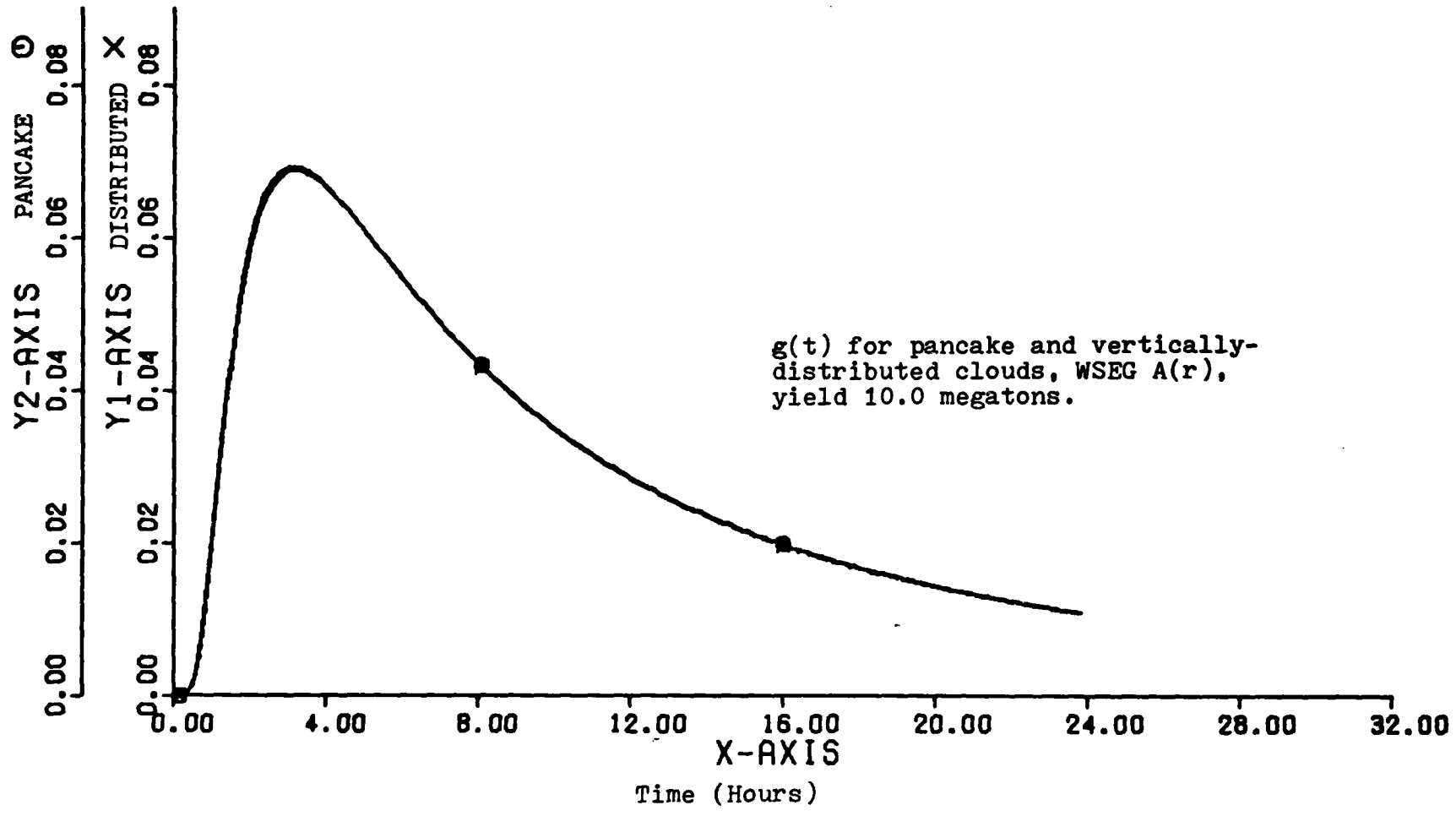

g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield .1 megaton.
Y1-AXIS DISTRIBUTED X
Y2-AXIS PANCAKE ⊙
0.00
0.04
0.08
0.12
0.16
X-AXIS
Time (Hours)
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00

Fig. C-3



g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield 10.0 megatons.

Fig. C-4

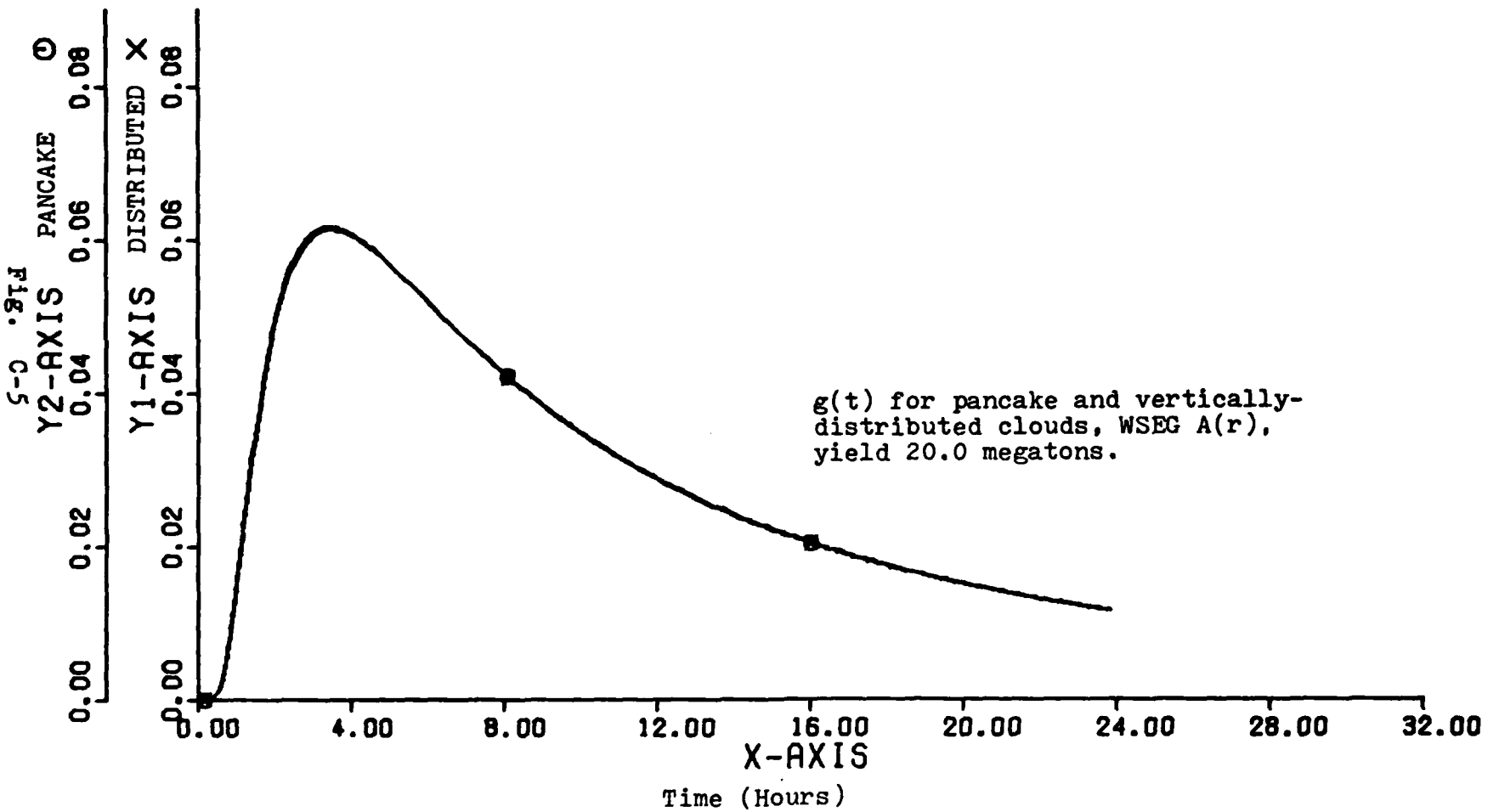


Fig. C-5

g(t) for pancake and vertically-distributed clouds, WSEG A(r), yield 20.0 megatons.

Appendix D Comparison with DELFIC

The DELFIC program (Ref 6) is the accepted DOD standard for fallout models. It is a detailed, long-running code, not easily applicable to a quick study of fallout effects.

For purposes of validation of the g(t) results presented herein, a DELFIC run was made at the Air Force Weapons Laboratory for a 100 KT surface burst. Representative g(t) and cumulative g(t) results from this run are plotted in figure D-1, along with a plot of g(t) and cumulative g(t) generated by the FALL code.

Since DELFIC and FALL differ in a number of respects, perfect agreement should not be expected. The closeness of the fit obtained is encouraging.

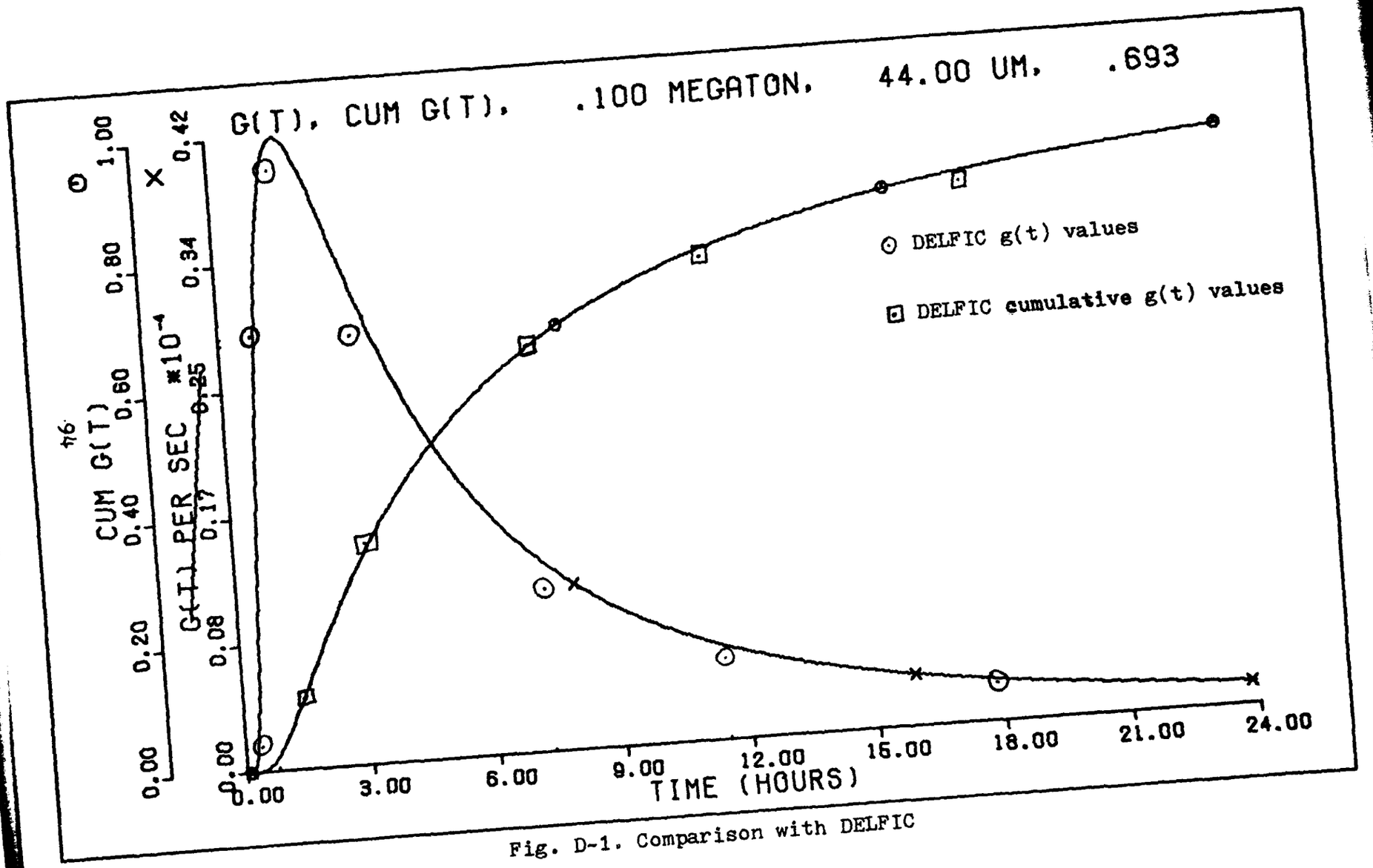


Fig. D-1. Comparison with DELFIC

Appendix E Results of Calculations

This Appendix contains the results of a number of runs of the FALL program. All results were produced through use of the pancake approximation. These exhibits are meant to demonstrate the flexibility of the program in terms of the ability of the user to vary the input parameters.

For each variation of an input parameter, the printed output of a program run is included. The g(t) and dose plots are also included, except that exhibits showing variation of parameters that do not affect g(t) (wind velocity, wind shear, and fission fraction) will not contain a g(t) plot.

List of Figures for

Appendix E

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .01 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .65

MAX G(T), .84142E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 59.540 RADS/HR, OCCURRED AT 6.25 KM

MAX ACCUM DOSE, 285.983 RADS, OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 81.979 RADS OCCURRED AT 18.75 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.84
AT	5.333	HOURS, CUMULATIVE G(T) IS	.95
AT	8.000	HOURS, CUMULATIVE G(T) IS	.98
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-1.

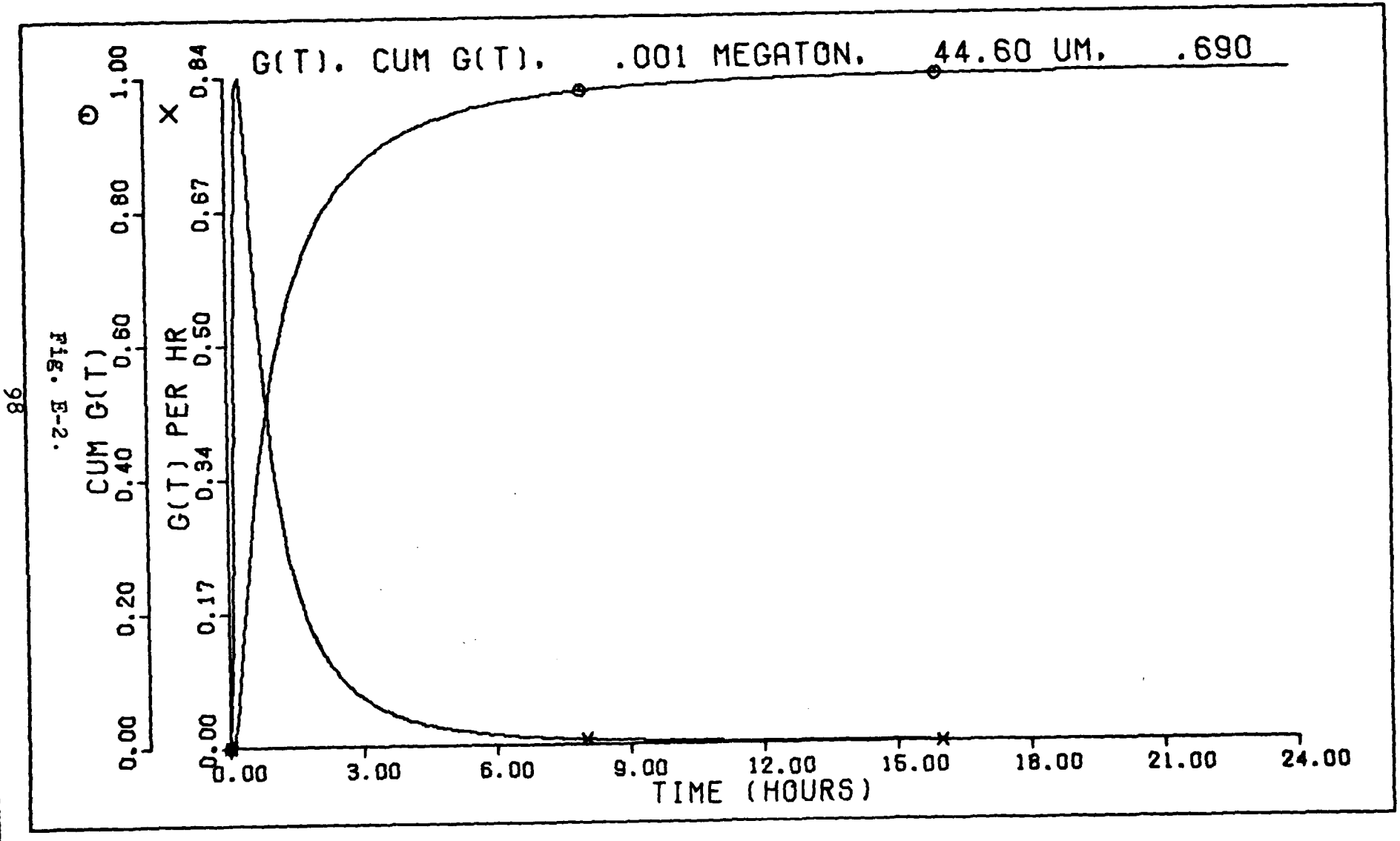
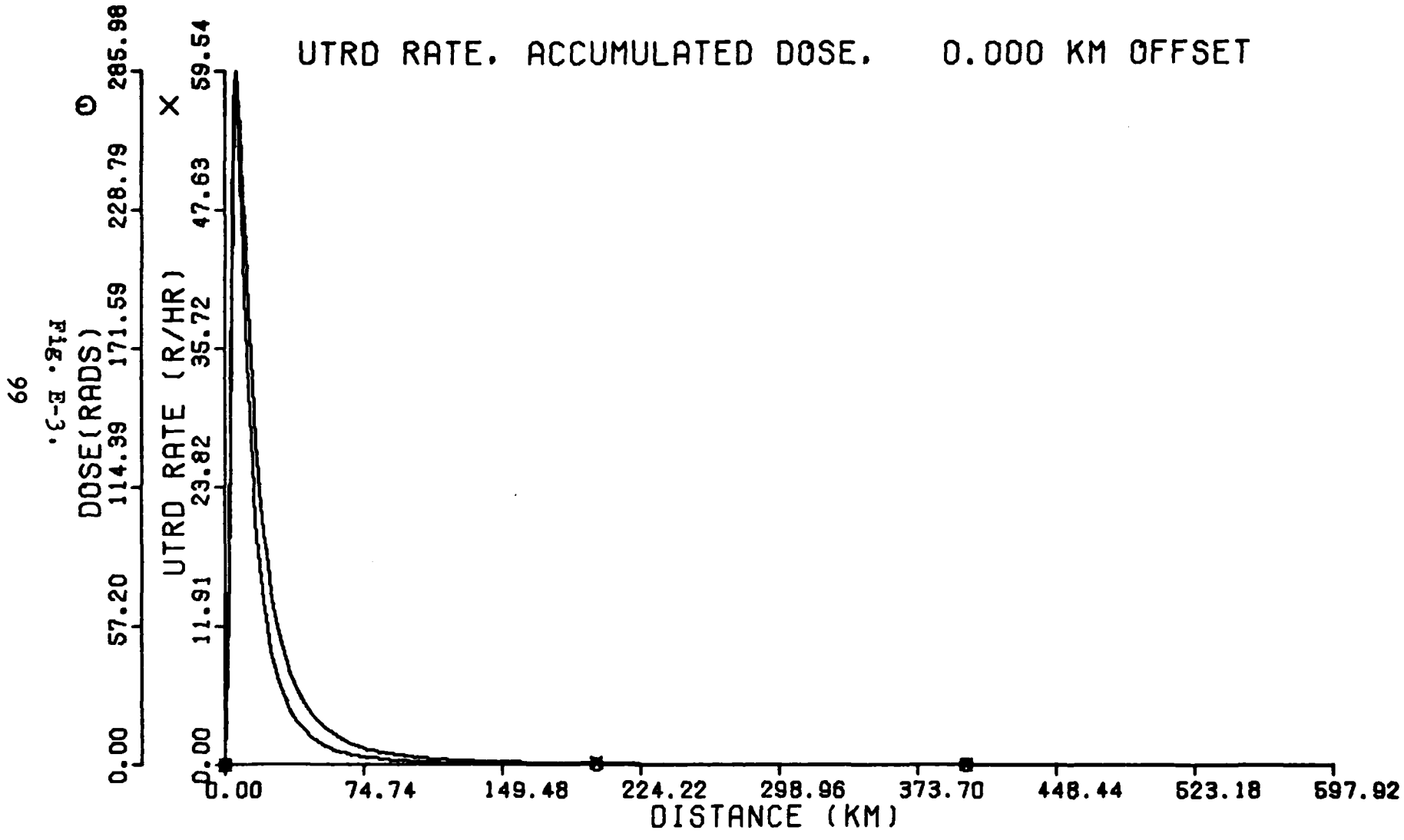

G(T). CUM G(T). .001 MEGATON. 44.60 UM. .690
Θ
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.17
0.34
0.50
0.67
0.84
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-2.


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS)
UTRD RATE (R/HR)
0.00
57.20
114.39
171.59
228.79
285.98
0.00
11.91
23.82
35.72
47.63
59.54
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
66
FIG. E-3.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .29695E+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 110.730 RADS/HR, OCCURRED AT 16.67 KM

MAX ACCUM DOSE, 410.718 RADS, OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 98.955 RADS OCCURRED AT 52.08 KM

UTRD RATE OF 94.610 RADS/HR OCCURRED AT 25.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.53
AT	5.333	HOURS, CUMULATIVE G(T) IS	.76
AT	8.000	HOURS, CUMULATIVE G(T) IS	.85
AT	10.667	HOURS, CUMULATIVE G(T) IS	.90
AT	13.333	HOURS, CUMULATIVE G(T) IS	.93
AT	16.000	HOURS, CUMULATIVE G(T) IS	.95
AT	18.667	HOURS, CUMULATIVE G(T) IS	.96
AT	21.333	HOURS, CUMULATIVE G(T) IS	.97

Fig. E-4.

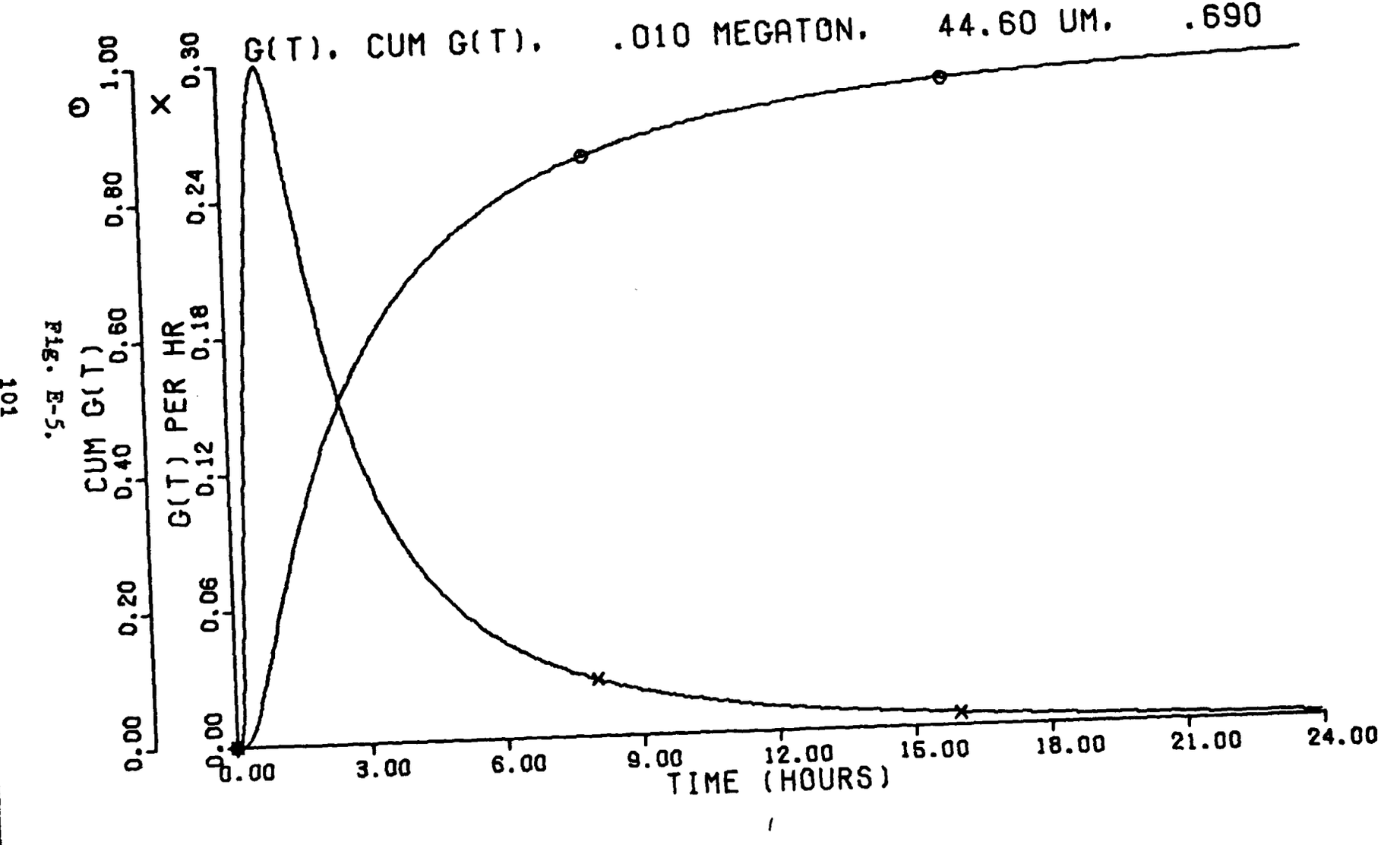
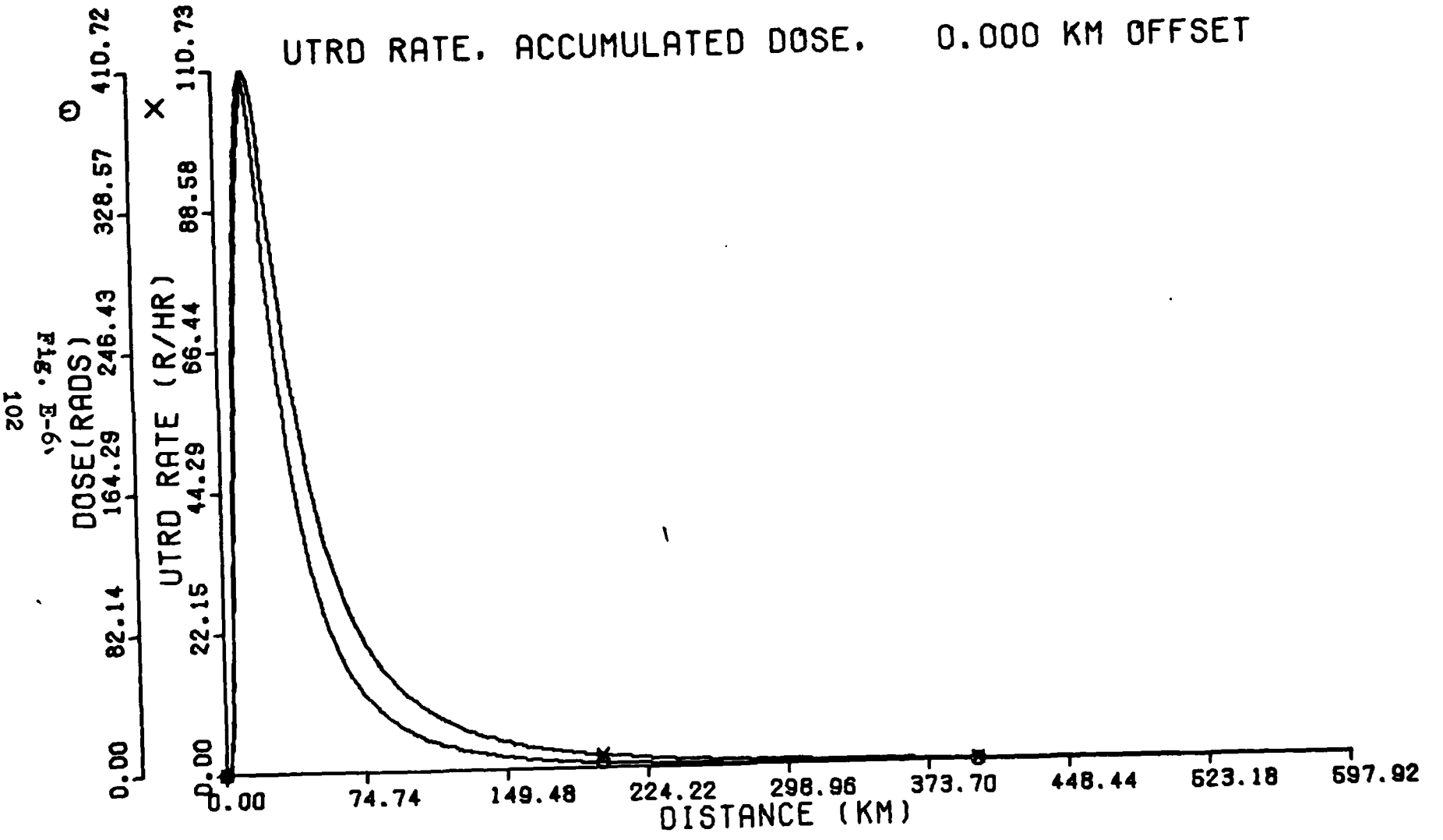

G(T). CUM G(T). .010 MEGATON. 44.60 UM. .690
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.06
0.12
0.18
0.24
0.30
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-5.


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS)
UTRD RATE (R/HR)
0.00
82.14
164.29
246.43
328.57
410.72
0.00
22.15
44.29
66.44
88.58
110.73
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .14371E+00 PER HR, OCCURRED AT 1.667 HOURS

MAX UTRD RATE, 198.324 RADS/HR, OCCURRED AT 31.25 KM

MAX ACCUM DOSE, 604.878 RADS, OCCURRED AT 27.08 KM

ACCUMULATED DOSE OF 496.689 RADS OCCURRED AT 41.67 KM

ACCUMULATED DOSE OF 99.375 RADS OCCURRED AT 112.50 KM

UTRD RATE OF 96.797 RADS/HR OCCURRED AT 77.08 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.333	HOURS, CUMULATIVE G(T) IS	.52
AT	8.000	HOURS, CUMULATIVE G(T) IS	.66
AT	10.667	HOURS, CUMULATIVE G(T) IS	.75
AT	13.333	HOURS, CUMULATIVE G(T) IS	.80
AT	16.000	HOURS, CUMULATIVE G(T) IS	.84
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.90

Fig. E-7.

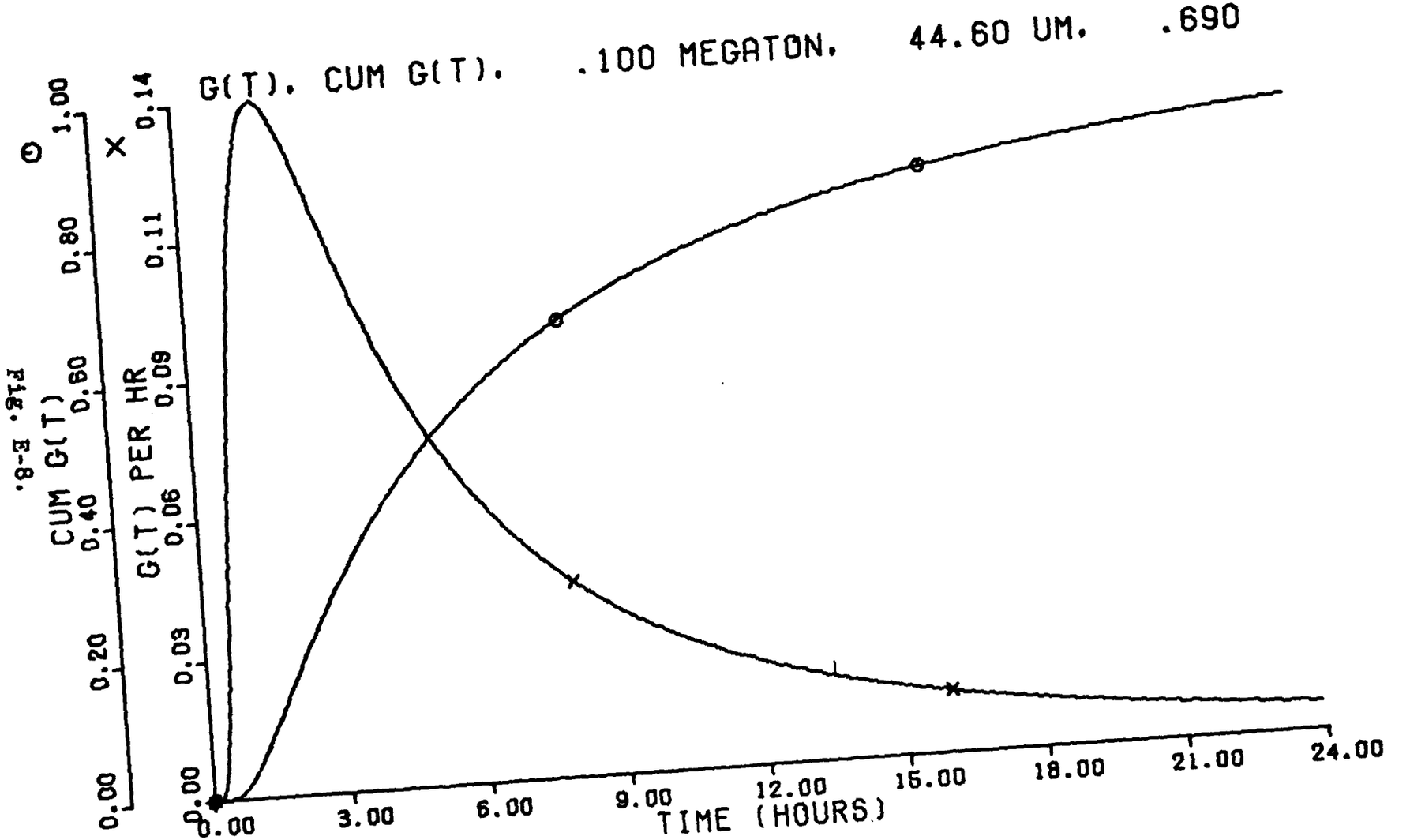
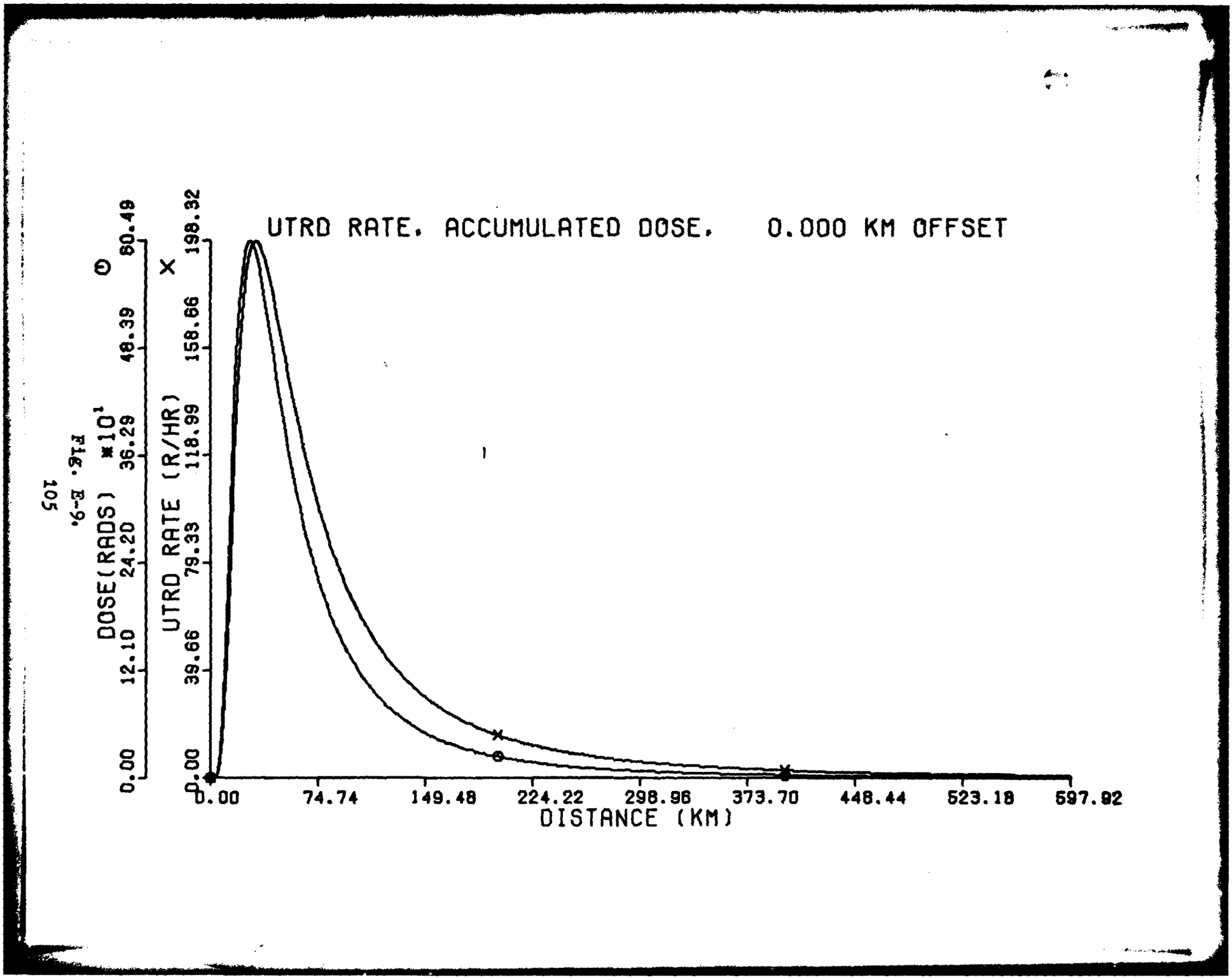

G(T). CUM G(T). .100 MEGATON. 44.60 UM. .690
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.03
0.06
0.09
0.11
0.14
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-8.


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
0.00
12.10
24.20
36.29
48.39
60.49
UTRD RATE (R/HR)
0.00
39.66
79.33
118.99
158.66
198.32
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
105
Fig. E-9.

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .70210E-01 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 2667.588 RADS/HR, OCCURRED AT 54.17 KM

MAX ACCUM DOSE, 6795.564 RADS, OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 990.447 RADS OCCURRED AT 206.25 KM

ACCUMULATED DOSE OF 498.918 RADS OCCURRED AT 275.00 KM

ACCUMULATED DOSE OF 99.518 RADS OCCURRED AT 491.67 KM

UTRD RATE OF 980.448 RADS/HR OCCURRED AT 164.58 KM

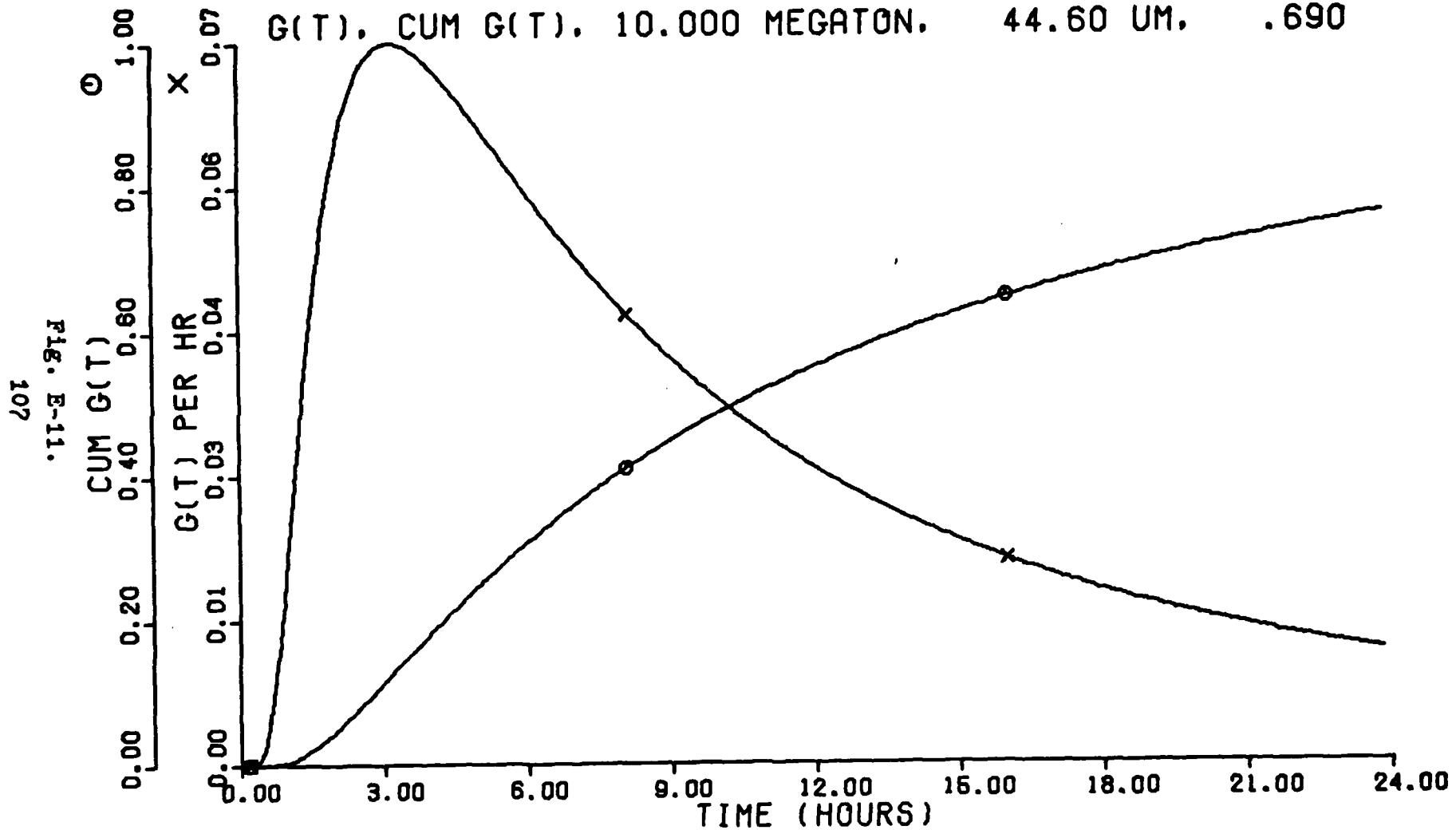
UTRD RATE OF 297.857 RADS/HR OCCURRED AT 313.42 KM

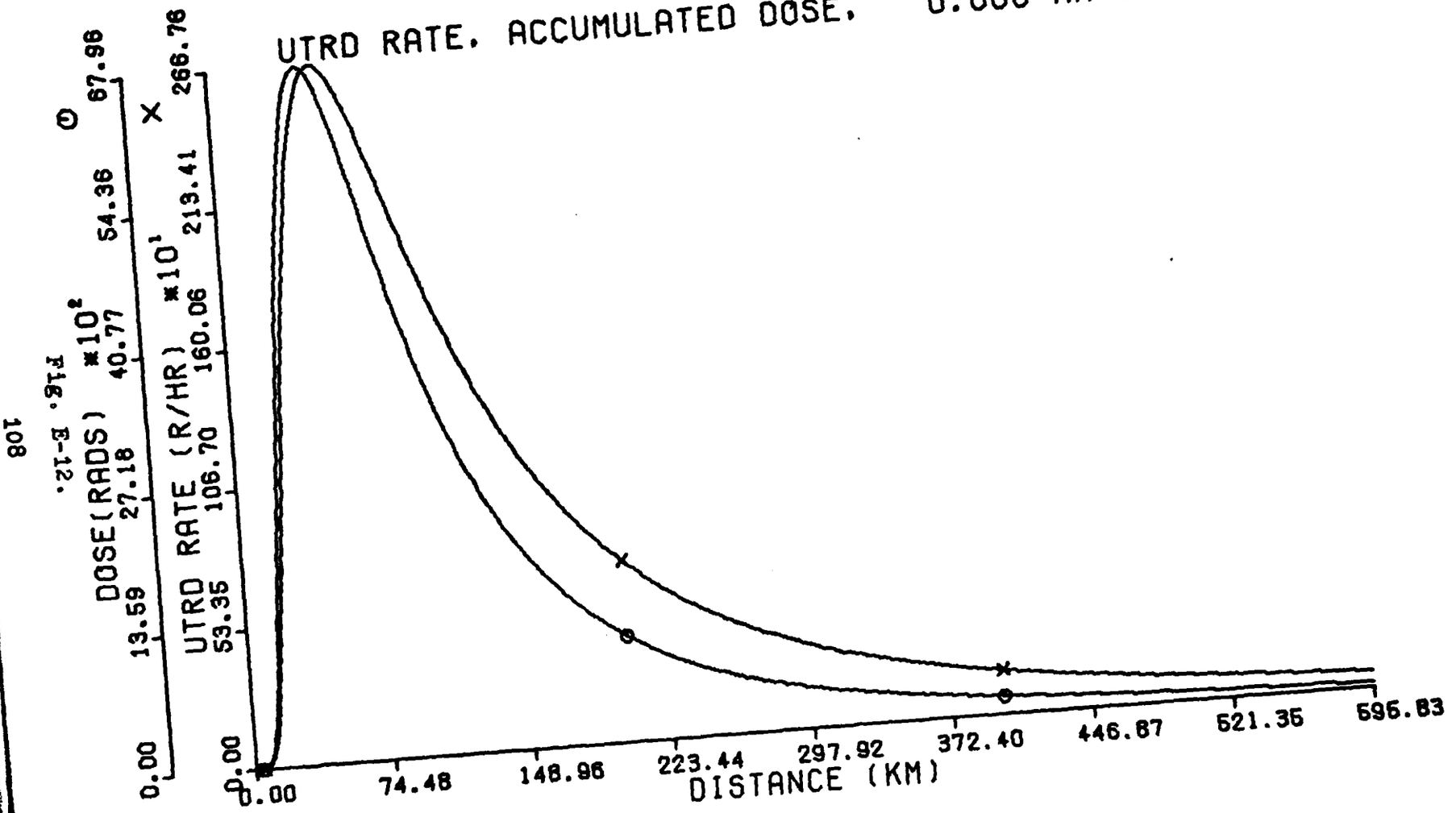
UTRD RATE OF 99.325 RADS/HR OCCURRED AT 500.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.10
AT	5.333	HOURS, CUMULATIVE G(T) IS	.27
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.50
AT	13.083	HOURS, CUMULATIVE G(T) IS	.58
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.69
AT	20.833	HOURS, CUMULATIVE G(T) IS	.72
AT	23.417	HOURS, CUMULATIVE G(T) IS	.76

Fig. E-10.


G(T), CUM G(T), 10.000 MEGATON, 44.60 UM, .690
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.01
0.03
0.04
0.06
0.07
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
FLE. E-11.
10⁷


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10¹
0.00
13.59
27.18
40.77
54.36
67.96
0.00
53.35
106.70
160.06
213.41
266.76
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

108

Fig. E-12.

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .62476E-01 PER HR, OCCURRED AT 3.500 HOURS

MAX UTRD RATE, 3277.166 RADS/HR, OCCURRED AT 60.42 KM

MAX ACCUM DOSE, 8053.879 RADS, OCCURRED AT 52.08 KM

ACCUMULATED DOSE OF 998.769 RADS OCCURRED AT 252.08 KM

ACCUMULATED DOSE OF 497.800 RADS OCCURRED AT 335.42 KM

ACCUMULATED DOSE OF 99.687 RADS OCCURRED AT 591.67 KM

UTRD RATE OF 2994.544 RADS/HR OCCURRED AT 83.33 KM

UTRD RATE OF 995.821 RADS/HR OCCURRED AT 212.50 KM

UTRD RATE OF 299.755 RADS/HR OCCURRED AT 393.75 KM

SELECTED CUMULATIVE G(T) DATA

AT .167 HOURS, CUMULATIVE G(T) IS 0.00
AT 2.750 HOURS, CUMULATIVE G(T) IS .08
AT 5.333 HOURS, CUMULATIVE G(T) IS .24
AT 7.917 HOURS, CUMULATIVE G(T) IS .36
AT 10.500 HOURS, CUMULATIVE G(T) IS .46
AT 13.083 HOURS, CUMULATIVE G(T) IS .54
AT 15.667 HOURS, CUMULATIVE G(T) IS .60
AT 18.250 HOURS, CUMULATIVE G(T) IS .65
AT 20.833 HOURS, CUMULATIVE G(T) IS .69
AT 23.417 HOURS, CUMULATIVE G(T) IS .72

Fig. E-13.

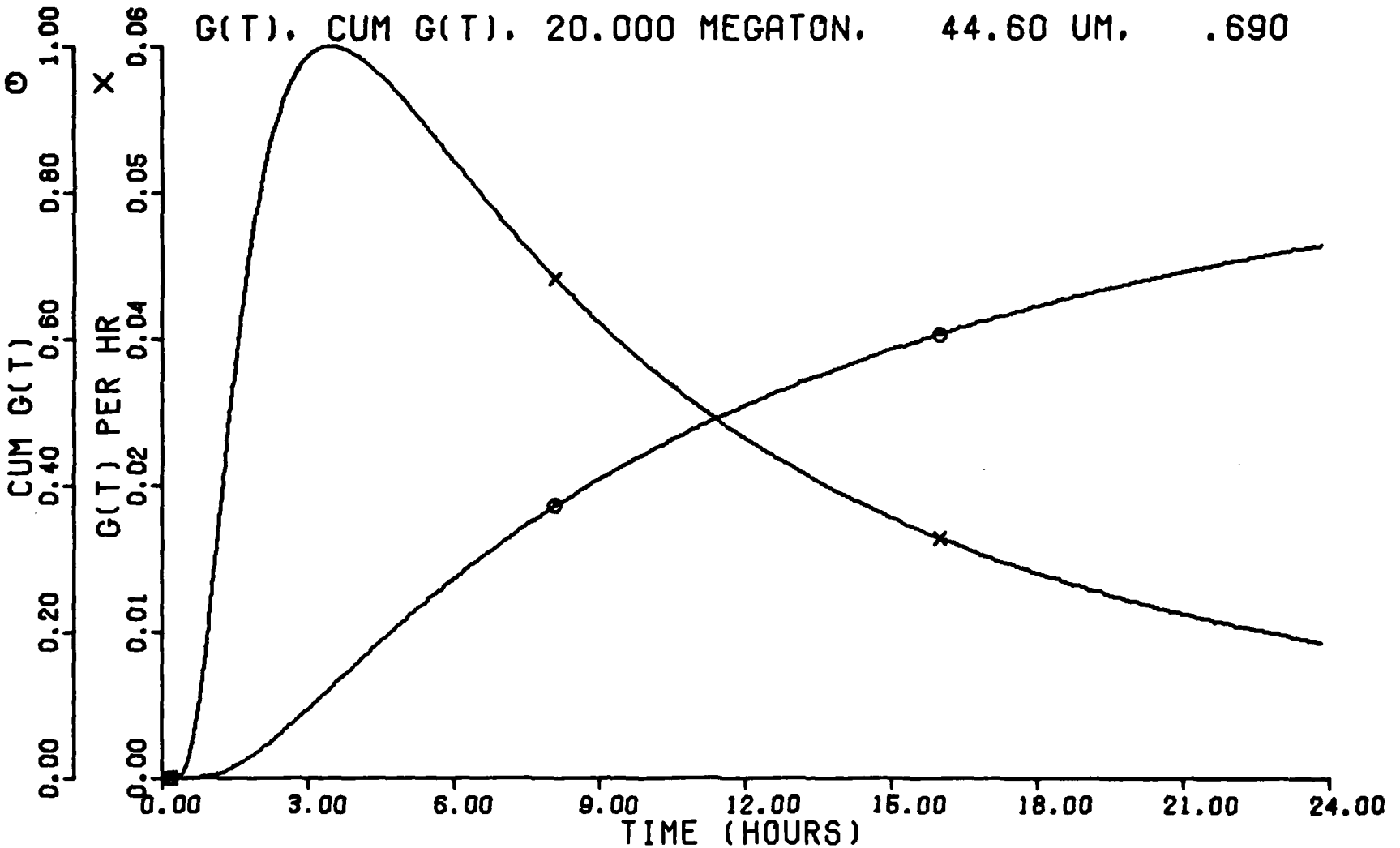
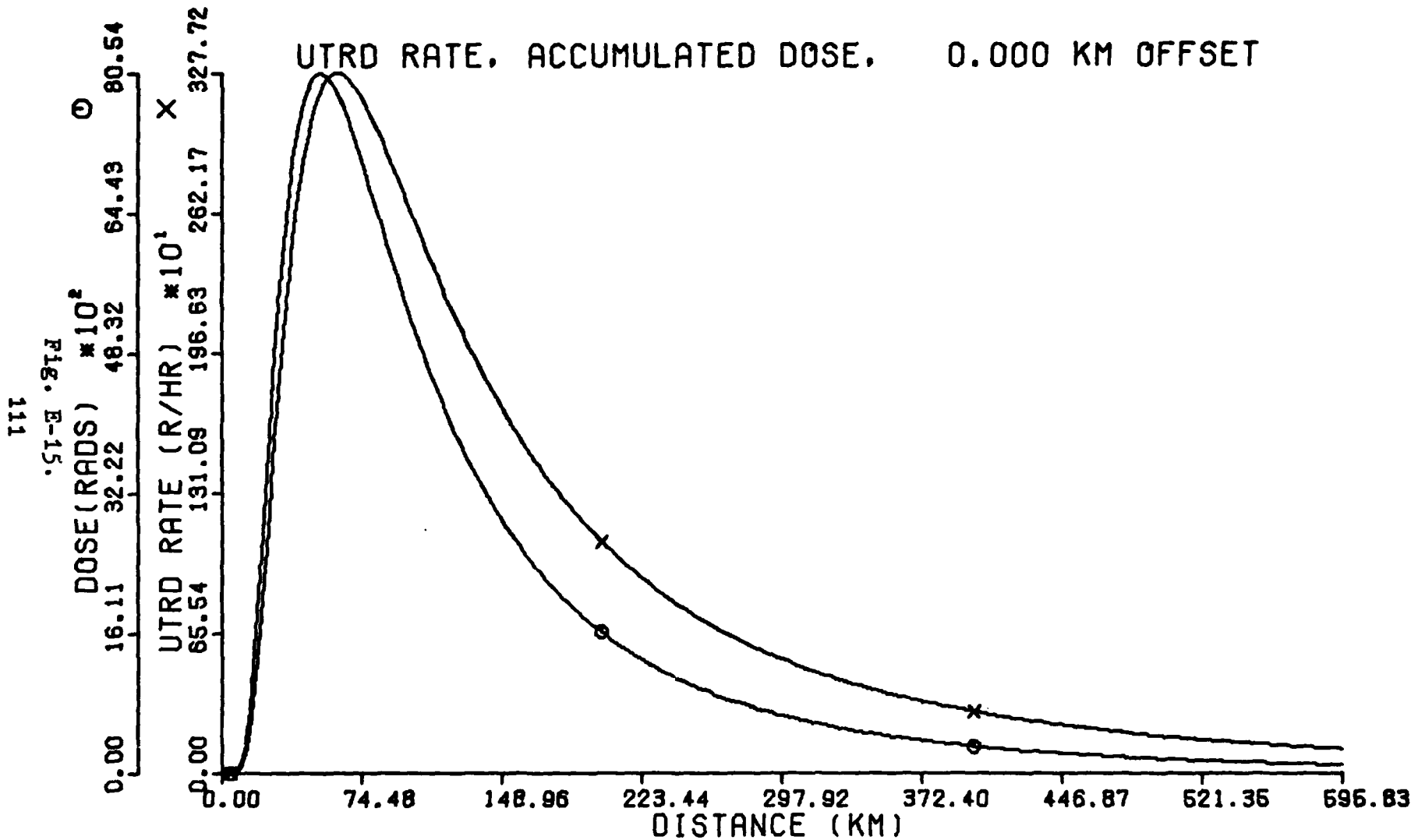

G(T). CUM G(T). 20.000 MEGATON. 44.60 UM. .690
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.01
0.02
0.04
0.05
0.06
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-14.


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10²
0.00 16.11 32.22 48.32 64.43 80.54
UTRD RATE (R/HR) *10¹
0.00 65.54 131.09 196.63 262.17 327.72
0.00 74.48 148.96 223.44 297.92 372.40 446.87 521.35 596.83
DISTANCE (KM)

111

Fig. E-15.

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .11 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .12458E+01 PER HR, OCCURRED AT .083 HOURS

MAX UTRD RATE, 121.361 RADS/HR, OCCURRED AT 2.08 KM

MAX ACCUM DOSE, 779.670 RADS, OCCURRED AT 2.08 KM

ACCUMULATED DOSE OF 414.312 RADS OCCURRED AT 4.17 KM

ACCUMULATED DOSE OF 78.993 RADS OCCURRED AT 12.50 KM

UTRD RATE OF 77.290 RADS/HR OCCURRED AT 4.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.62
AT	5.333	HOURS, CUMULATIVE G(T) IS	.72
AT	8.000	HOURS, CUMULATIVE G(T) IS	.78
AT	10.667	HOURS, CUMULATIVE G(T) IS	.81
AT	13.333	HOURS, CUMULATIVE G(T) IS	.83
AT	16.000	HOURS, CUMULATIVE G(T) IS	.85
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.88

Fig. E-16.

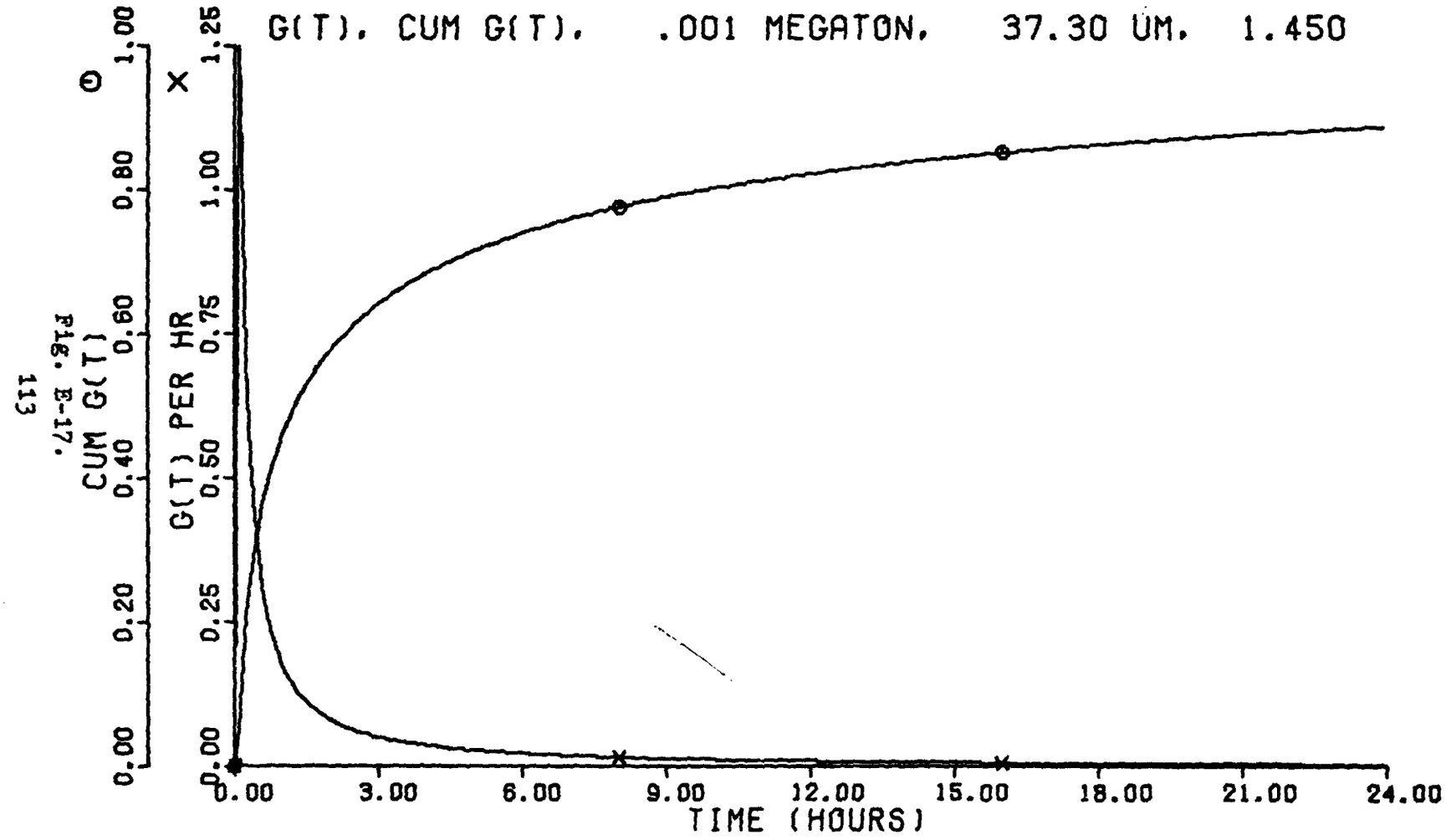

G(T), CUM G(T), .001 MEGATON, 37.30 UM, 1.450
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.25
0.50
0.75
1.25
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-17.

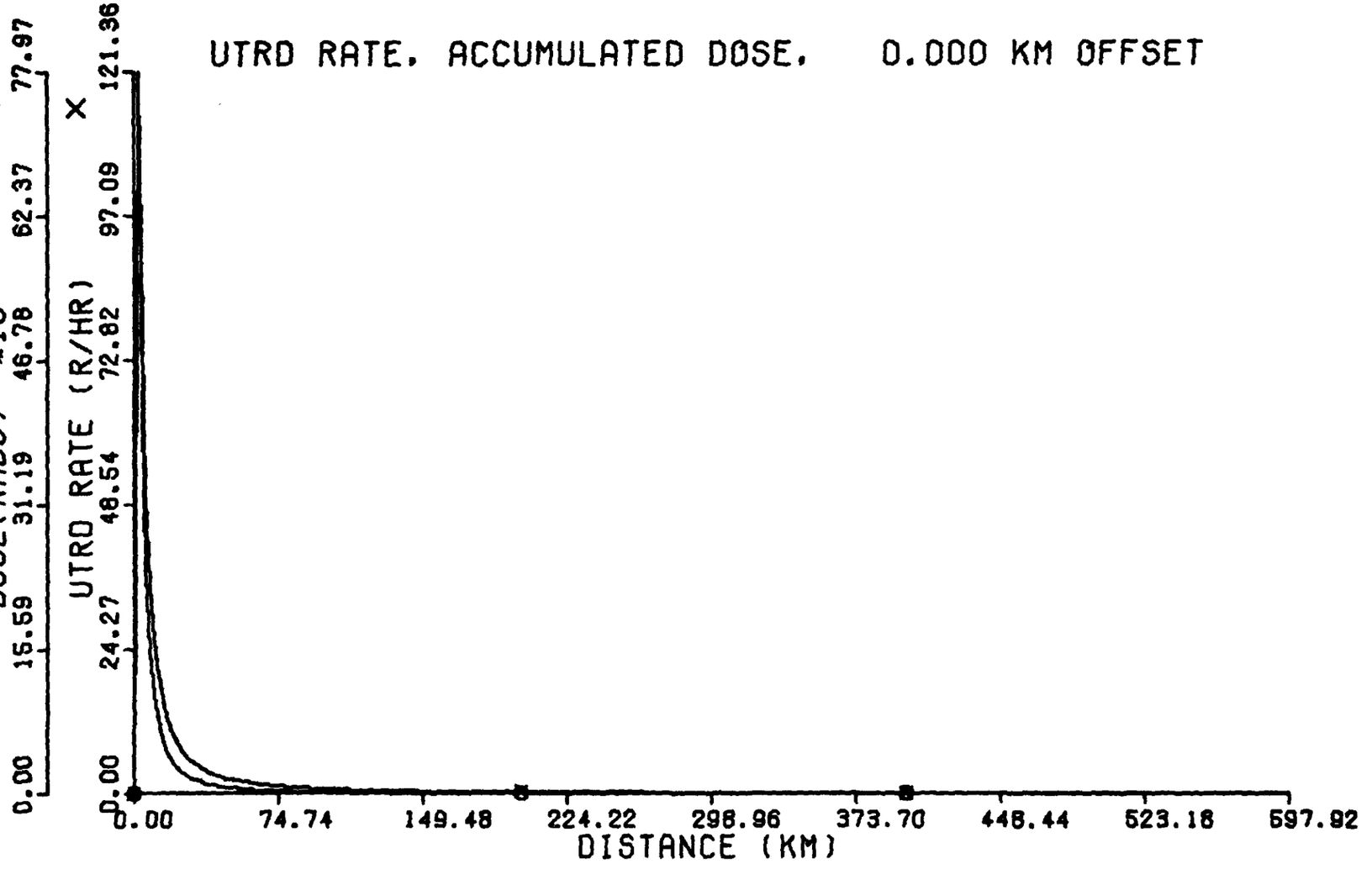

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
0.00
15.59
31.19
46.78
62.37
77.97
Θ
UTRD RATE (R/HR)
0.00
24.27
48.54
72.82
97.09
121.36
X
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. B-18.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .43751E+00 PER HR, OCCURRED AT .167 HOURS

MAX UTRD RATE, 252.548 RADS/HR, OCCURRED AT 4.17 KM

MAX ACCUM DOSE, 1353.783 RADS, OCCURRED AT 4.17 KM

ACCUMULATED DOSE OF 874.446 RADS OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 441.393 RADS OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 99.058 RADS OCCURRED AT 35.42 KM

UTRD RATE OF 99.788 RADS/HR OCCURRED AT 16.67 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.47
AT	5.333	HOURS, CUMULATIVE G(T) IS	.58
AT	8.000	HOURS, CUMULATIVE G(T) IS	.65
AT	10.667	HOURS, CUMULATIVE G(T) IS	.69
AT	13.333	HOURS, CUMULATIVE G(T) IS	.72
AT	16.000	HOURS, CUMULATIVE G(T) IS	.75
AT	18.667	HOURS, CUMULATIVE G(T) IS	.77
AT	21.333	HOURS, CUMULATIVE G(T) IS	.78

Fig. E-19.

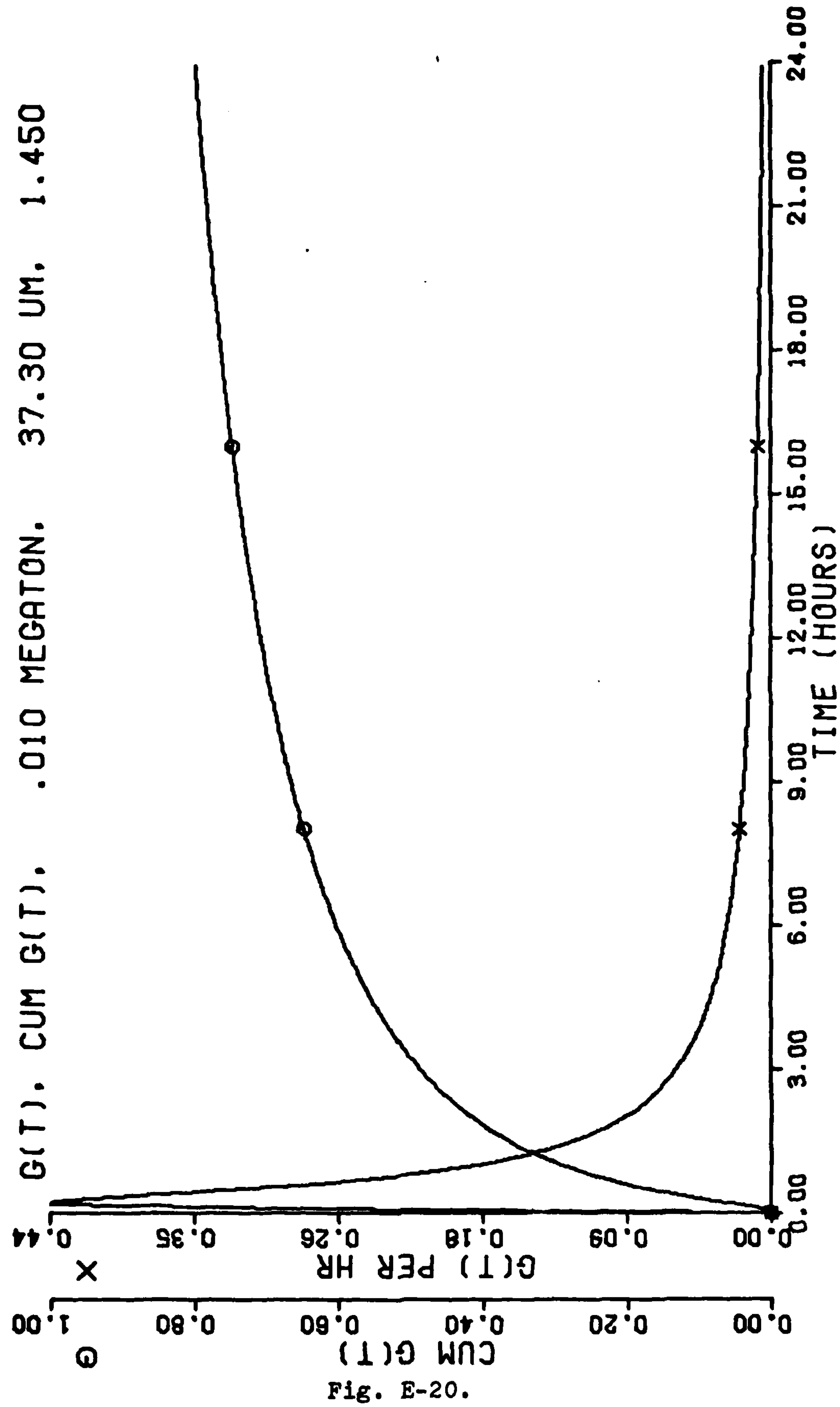
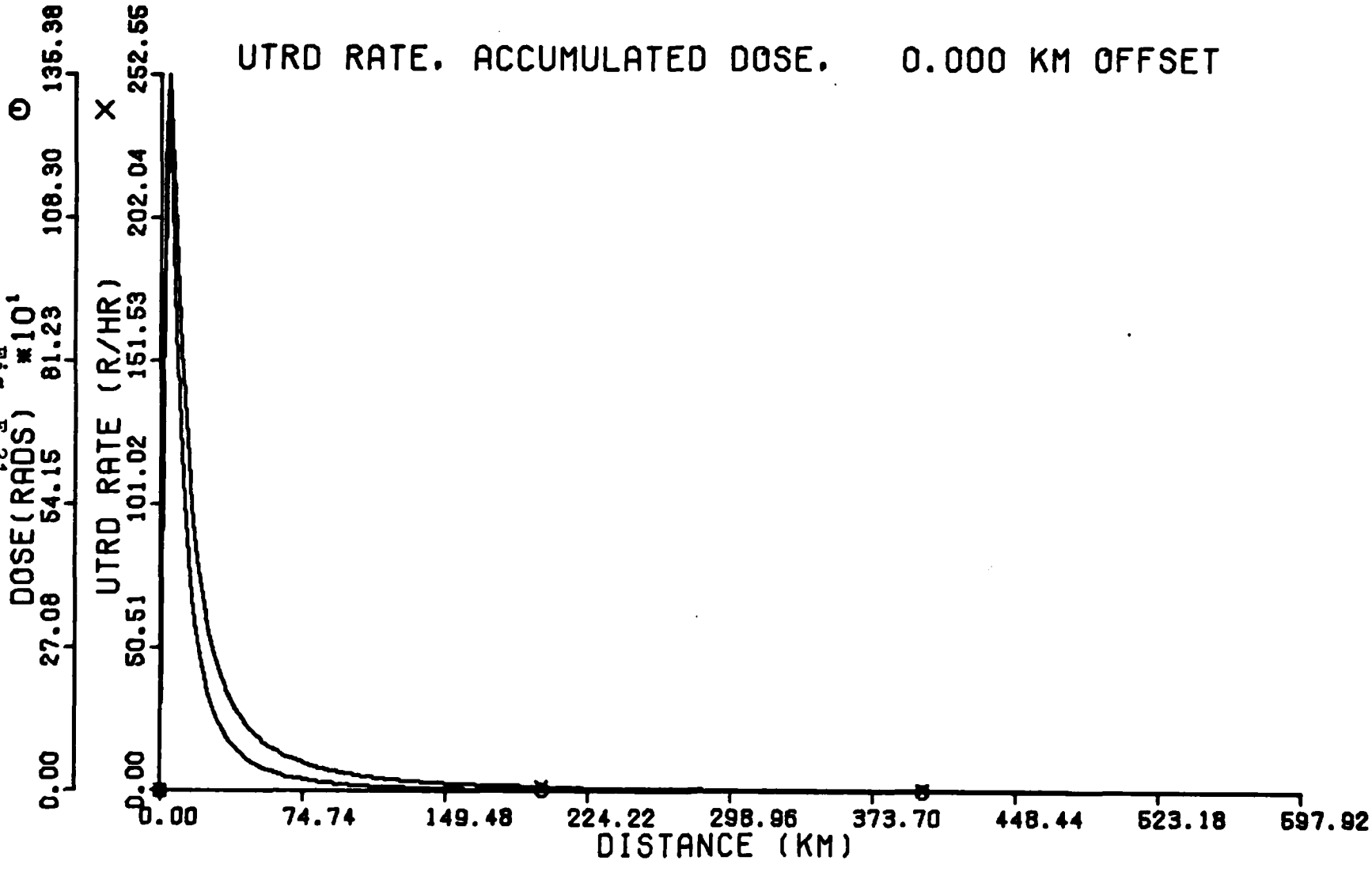

G(T). CUM G(T). .010 MEGATON. 37.30 UM. 1.450
TIME (HOURS)
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
G(T) PER HR
0.00
0.09
0.18
0.26
0.35
0.44
CUM G(T)
0.00
0.20
0.40
0.60
0.80
1.00

Fig. E-20.


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹ Fig. E-21.
0.00
27.08
54.15
81.23
108.30
135.38
UTRD RATE (R/HR)
0.00
50.51
101.02
151.53
202.04
252.55
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .21971E+00 PER HR, OCCURRED AT .417 HOURS

MAX UTRD RATE, 507.334 RADS/HR, OCCURRED AT 8.33 KM

MAX ACCUM DOSE, 2364.147 RADS, OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 938.364 RADS OCCURRED AT 22.92 KM

ACCUMULATED DOSE OF 477.931 RADS OCCURRED AT 35.42 KM

ACCUMULATED DOSE OF 95.418 RADS OCCURRED AT 81.25 KM

UTRD RATE OF 285.073 RADS/HR OCCURRED AT 22.92 KM

UTRD RATE OF 99.788 RADS/HR OCCURRED AT 50.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.34
AT	5.333	HOURS, CUMULATIVE G(T) IS	.46
AT	8.000	HOURS, CUMULATIVE G(T) IS	.53
AT	10.667	HOURS, CUMULATIVE G(T) IS	.57
AT	13.333	HOURS, CUMULATIVE G(T) IS	.61
AT	16.000	HOURS, CUMULATIVE G(T) IS	.64
AT	18.667	HOURS, CUMULATIVE G(T) IS	.66
AT	21.333	HOURS, CUMULATIVE G(T) IS	.68

Fig. E-22.

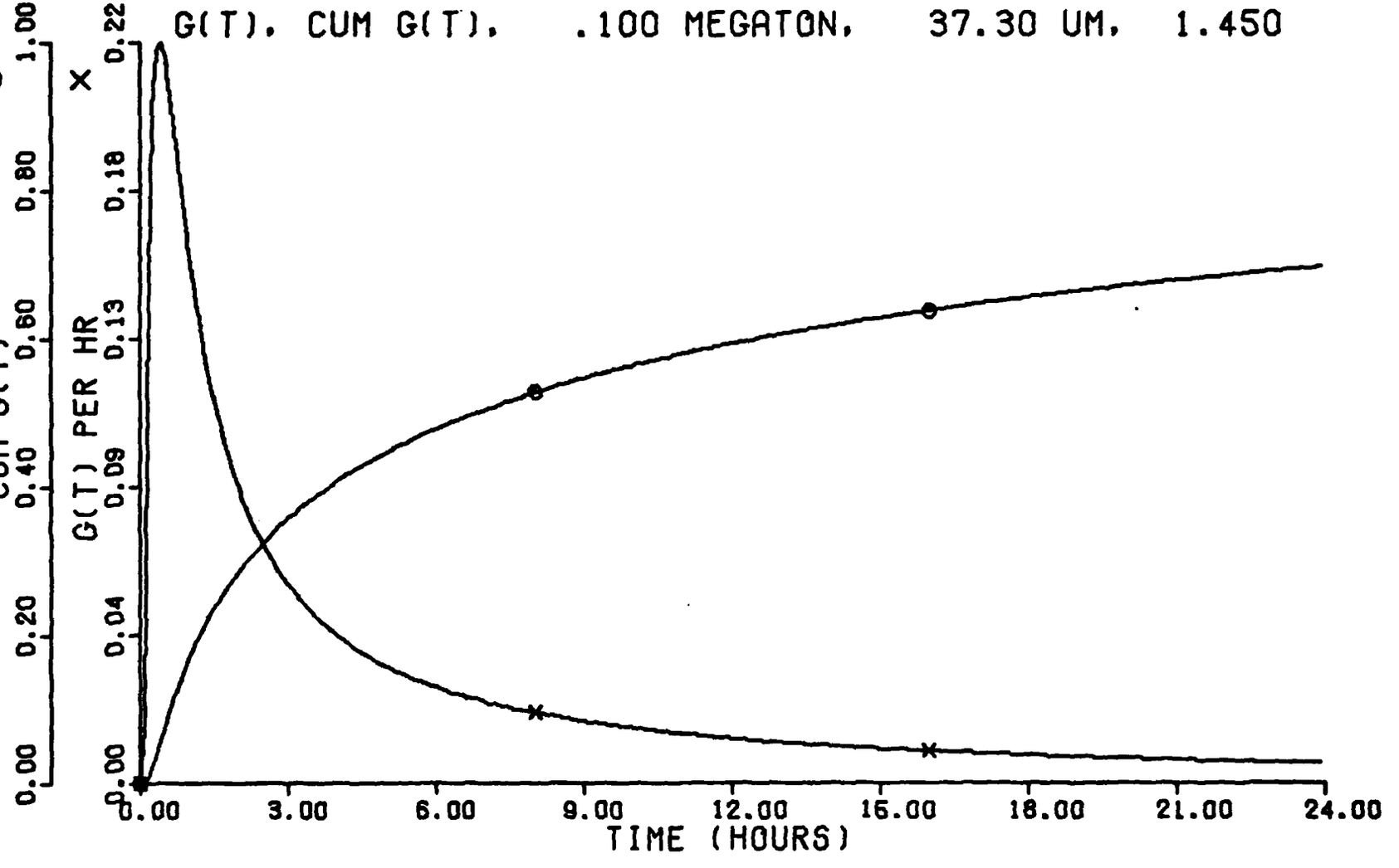
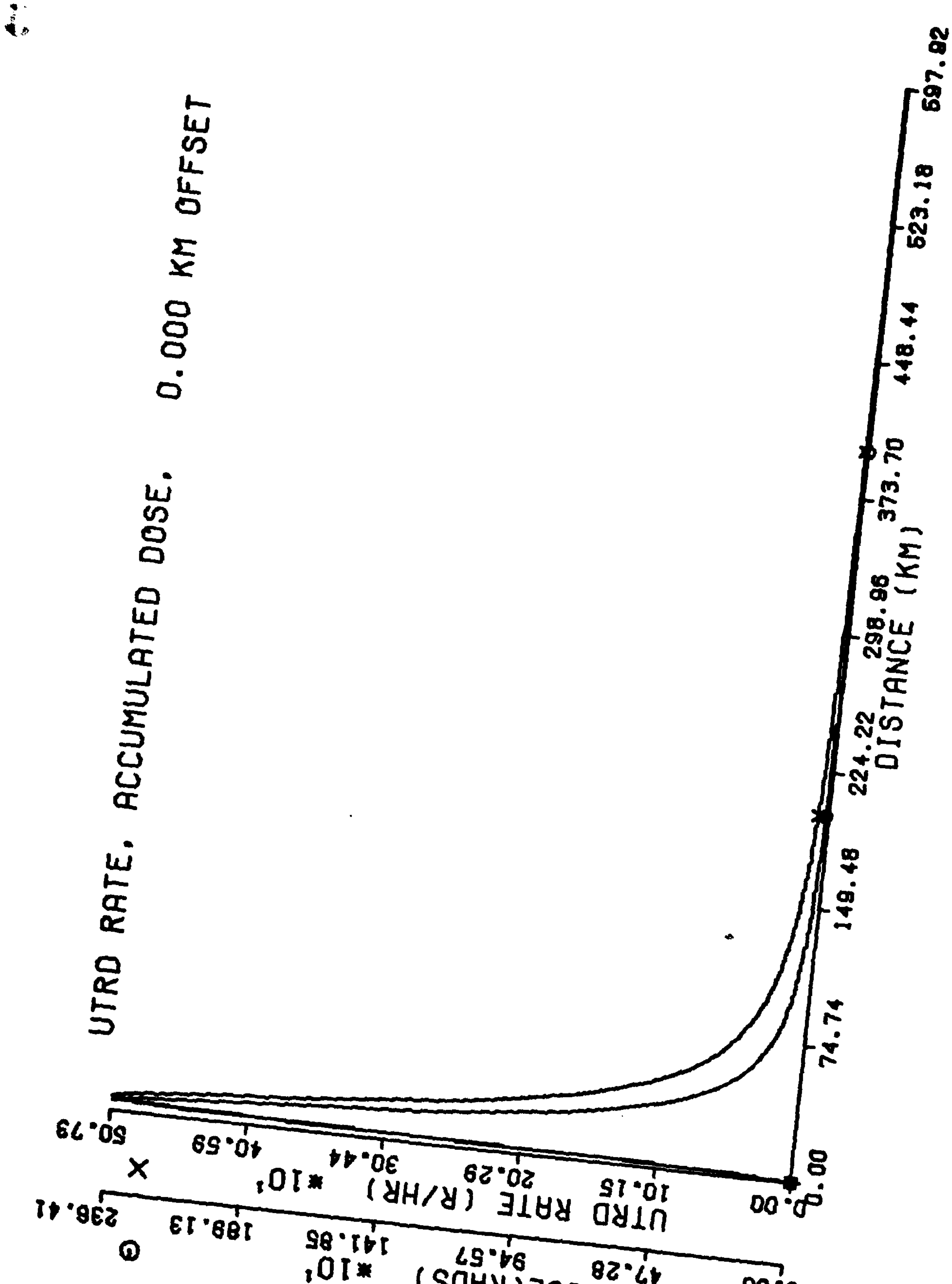

G(T). CUM G(T). .100 MEGATON. 37.30 UM. 1.450
Θ
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.04
0.09
0.13
0.18
0.22
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-23.



UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
UTRD RATE (R/HR) *10¹
0.00
10.15
20.29
30.44
40.59
50.73
DOSE(RADS) *10¹
0.00
47.28
94.57
141.85
189.13
236.41

Fig. E-24.

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .11736E+00 PER HR, OCCURRED AT .667 HOURS

MAX UTRD RATE, 8152.536 RADS/HR, OCCURRED AT 12.50 KM

MAX ACCUM DOSE, 32961.527 RADS, OCCURRED AT 13.42 KM

ACCUMULATED DOSE OF 973.601 RADS OCCURRED AT 150.00 KM

ACCUMULATED DOSE OF 492.868 RADS OCCURRED AT 202.08 KM

ACCUMULATED DOSE OF 99.424 RADS OCCURRED AT 389.58 KM

UTRD RATE OF 2994.483 RADS/HR OCCURRED AT 54.17 KM

UTRD RATE OF 986.522 RADS/HR OCCURRED AT 110.42 KM

UTRD RATE OF 299.133 RADS/HR OCCURRED AT 212.50 KM

UTRD RATE OF 99.368 RADS/HR OCCURRED AT 372.92 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.23
AT	5.333	HOURS, CUMULATIVE G(T) IS	.34
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.45
AT	13.083	HOURS, CUMULATIVE G(T) IS	.49
AT	15.667	HOURS, CUMULATIVE G(T) IS	.52
AT	18.250	HOURS, CUMULATIVE G(T) IS	.54
AT	20.833	HOURS, CUMULATIVE G(T) IS	.56
AT	23.417	HOURS, CUMULATIVE G(T) IS	.58

Fig. E-25.

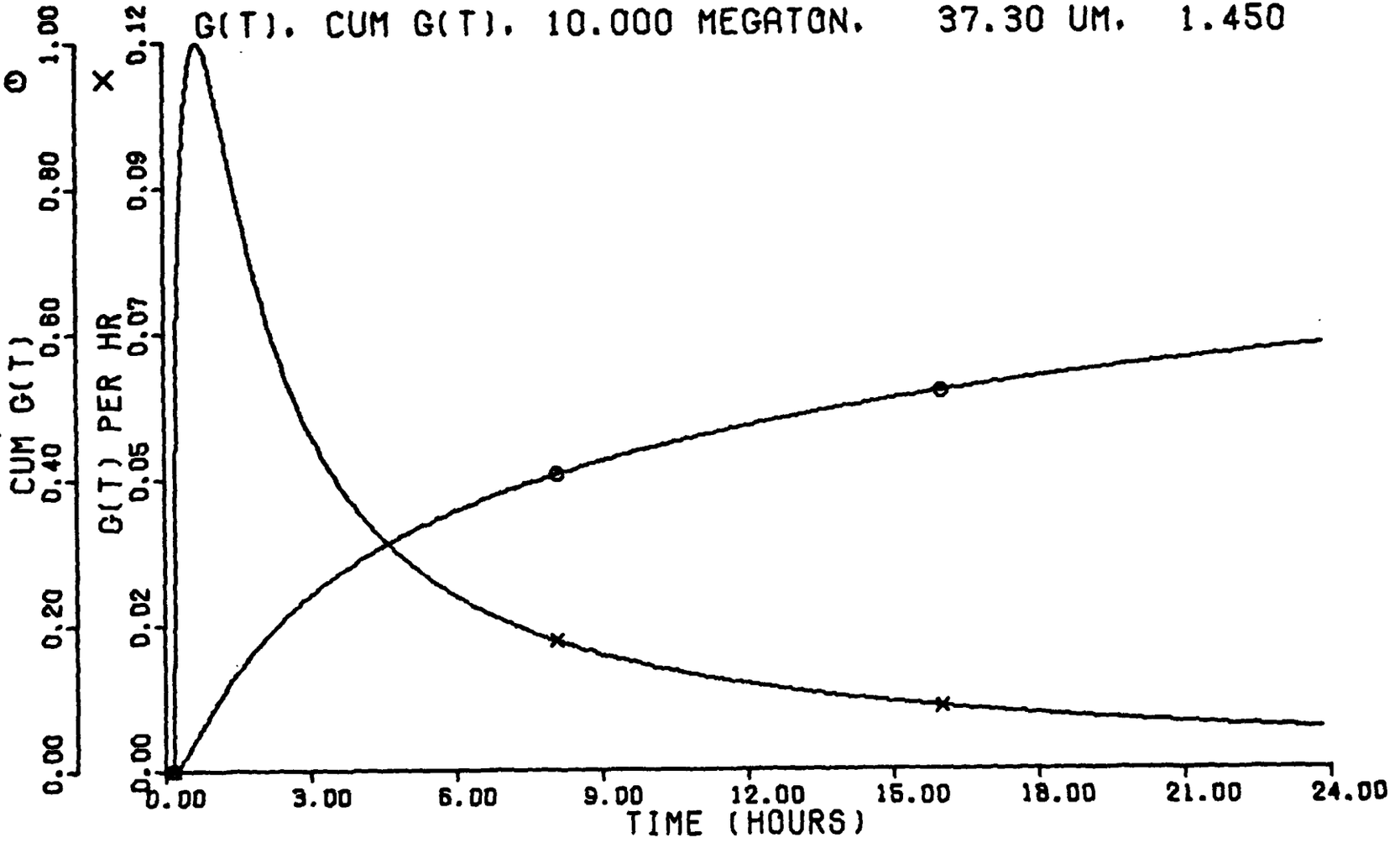

G(T), CUM G(T), 10.000 MEGATON, 37.30 UM, 1.450
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.02
0.05
0.07
0.09
0.12
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-26.

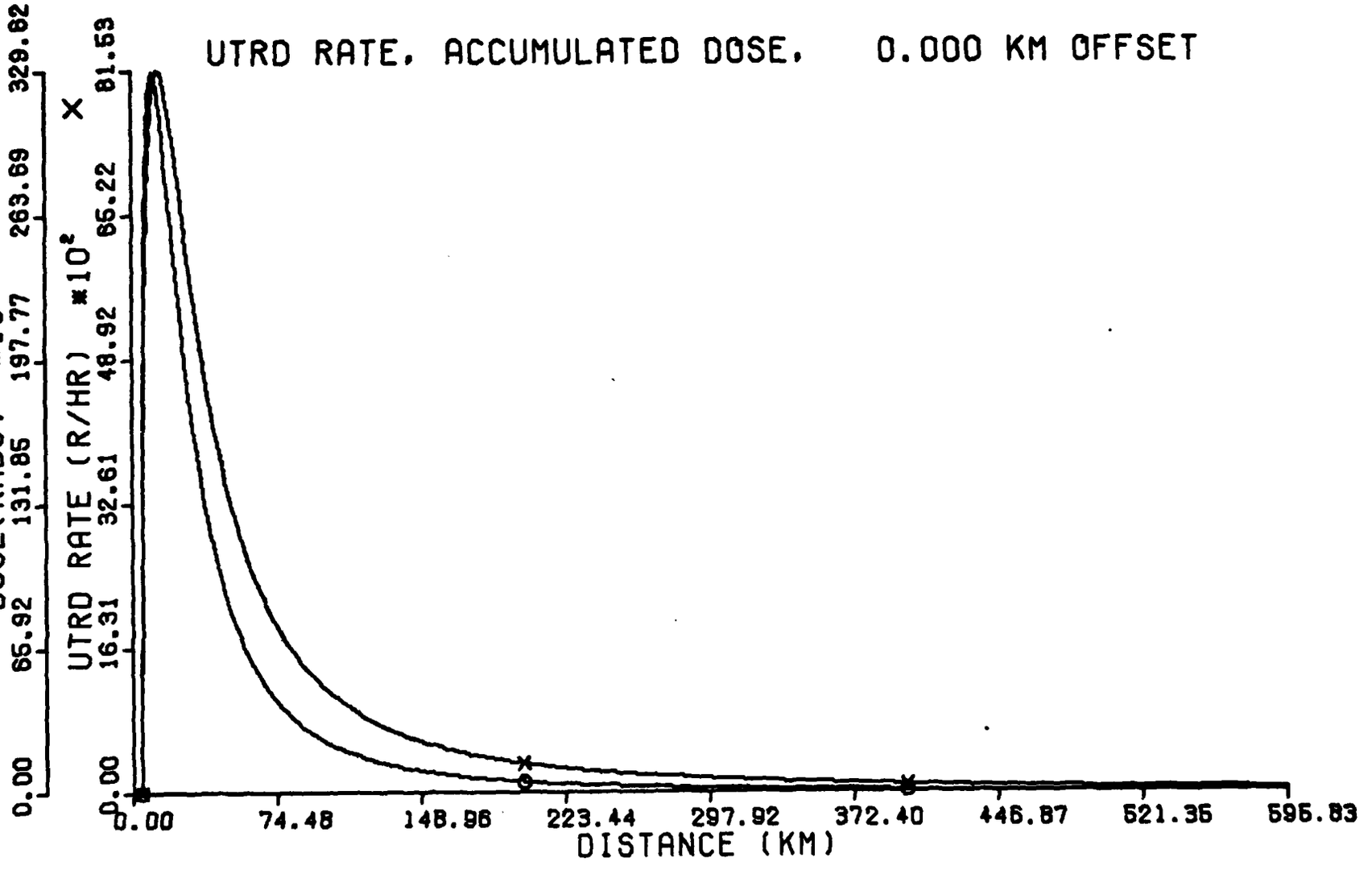

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10²
0.00
65.92
131.85
197.77
263.69
329.62
0.00
16.31
32.61
48.92
65.22
81.53
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. E-27.
123

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 37.30 MICRONS, SLOPE 1.45

MAX G(T), .10748E+00 PER HR, OCCURRED AT .750 HOURS

MAX UTRD RATE, 9768.007 RADS/HR, OCCURRED AT 14.58 KM

MAX ACCUM DOSE, 38601.039 RADS, OCCURRED AT 13.42 KM

ACCUMULATED DOSE OF 998.978 RADS OCCURRED AT 181.25 KM

ACCUMULATED DOSE OF 499.609 RADS OCCURRED AT 245.83 KM

ACCUMULATED DOSE OF 99.566 RADS OCCURRED AT 475.00 KM

UTRD RATE OF 2903.726 RADS/HR OCCURRED AT 70.83 KM

UTRD RATE OF 979.249 RADS/HR OCCURRED AT 141.67 KM

UTRD RATE OF 299.382 RADS/HR OCCURRED AT 272.92 KM

UTRD RATE OF 99.797 RADS/HR OCCURRED AT 379.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.21
AT	5.333	HOURS, CUMULATIVE G(T) IS	.32
AT	7.917	HOURS, CUMULATIVE G(T) IS	.38
AT	10.500	HOURS, CUMULATIVE G(T) IS	.43
AT	13.083	HOURS, CUMULATIVE G(T) IS	.47
AT	15.667	HOURS, CUMULATIVE G(T) IS	.50
AT	18.250	HOURS, CUMULATIVE G(T) IS	.52
AT	20.833	HOURS, CUMULATIVE G(T) IS	.54
AT	23.417	HOURS, CUMULATIVE G(T) IS	.56

Fig. E-28

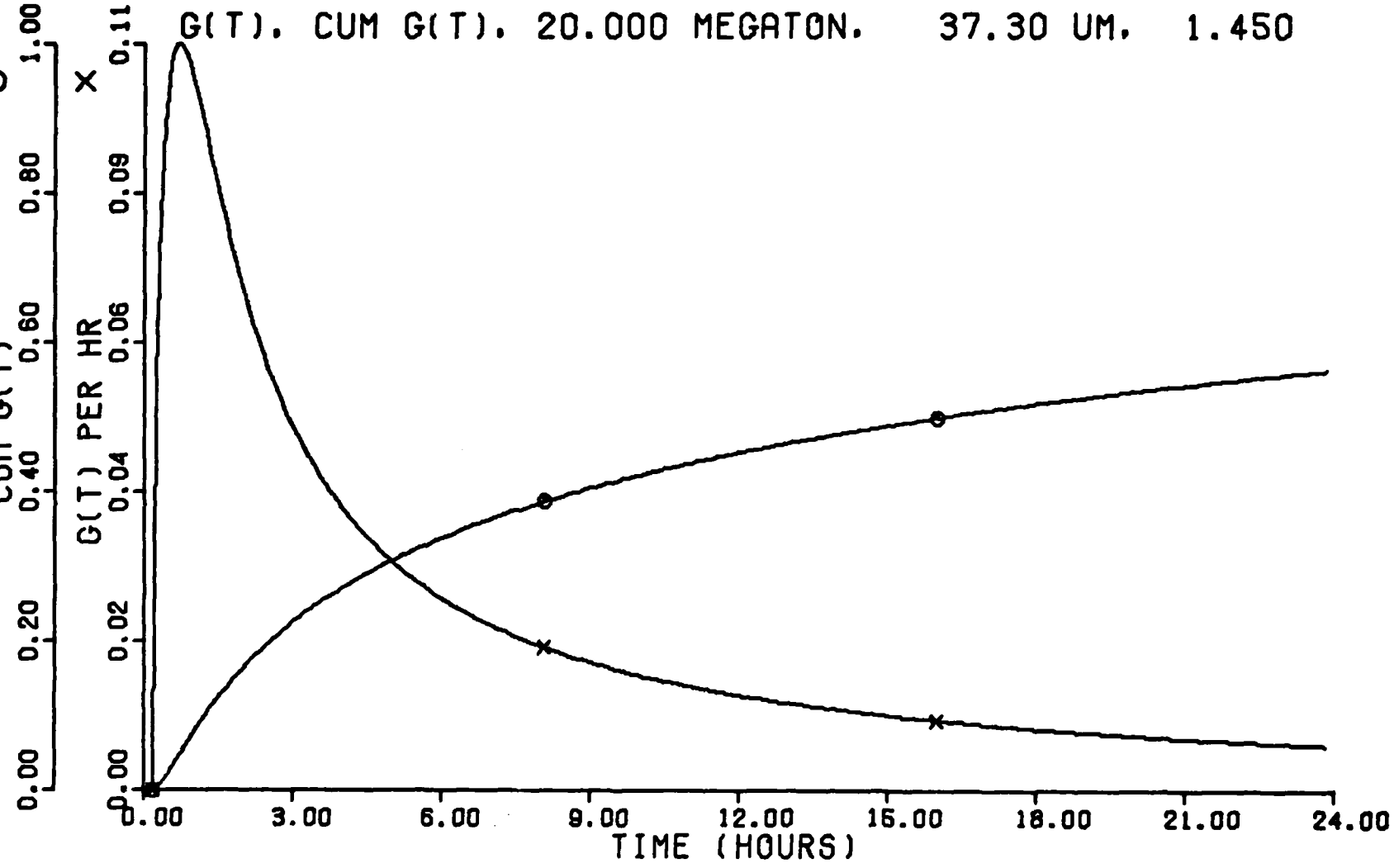
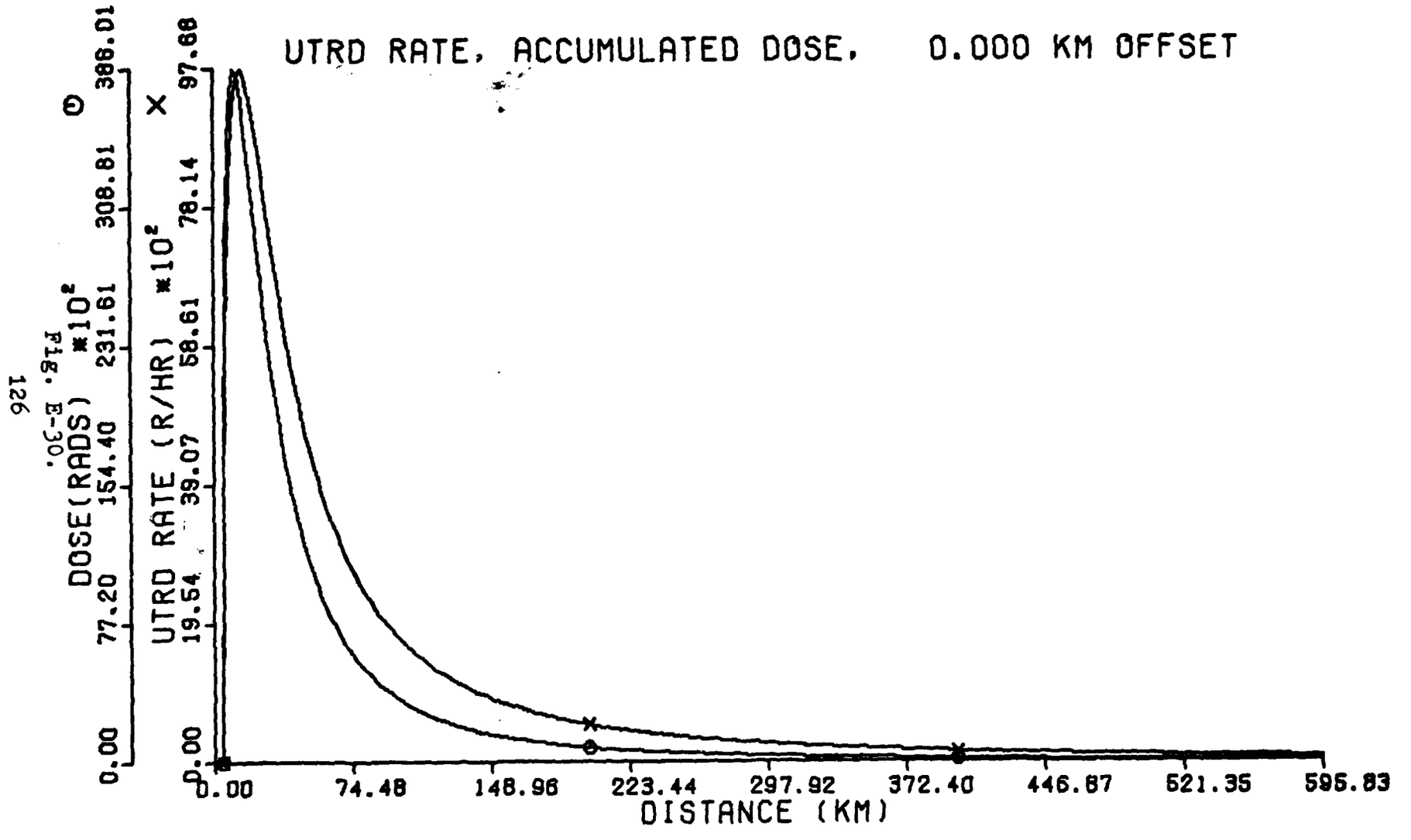

G(T). CUM G(T). 20.000 MEGATON. 37.30 UM. 1.450
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.02
0.04
0.06
0.09
0.11
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-29.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10²
0.00
77.20
154.40
231.61
308.81
386.01
0.00
19.54
39.07
58.61
78.14
97.68
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

126

Fig. E-30.

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .41 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .21743E+01 PER HR, OCCURRED AT .417 HOURS

MAX UTRD RATE, 137.313 RADS/HR, OCCURRED AT 8.33 KM

MAX ACCUM DOSE, 608.886 RADS, OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 392.804 RADS OCCURRED AT 12.50 KM

ACCUMULATED DOSE OF 68.947 RADS OCCURRED AT 20.83 KM

UTRD RATE OF 99.466 RADS/HR OCCURRED AT 12.50 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T)	IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T)	IS	1.00
AT	5.333	HOURS, CUMULATIVE G(T)	IS	1.00
AT	8.000	HOURS, CUMULATIVE G(T)	IS	1.00
AT	10.667	HOURS, CUMULATIVE G(T)	IS	1.00
AT	13.333	HOURS, CUMULATIVE G(T)	IS	1.00
AT	16.000	HOURS, CUMULATIVE G(T)	IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T)	IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T)	IS	1.00

Fig. E-31.

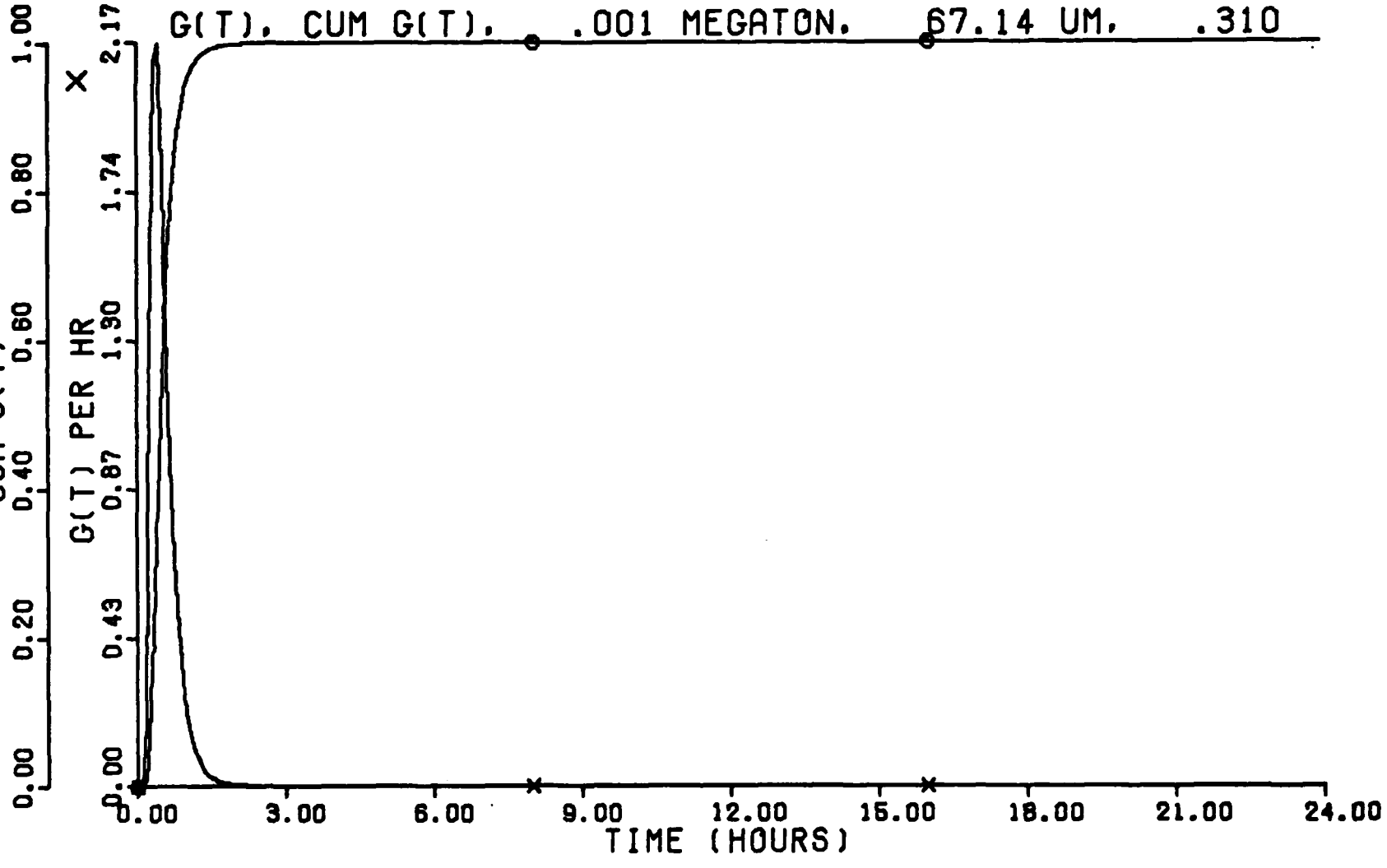

G(T), CUM G(T), .001 MEGATON, 67.14 UM, .310
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.43
0.87
1.30
1.74
2.17
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-32

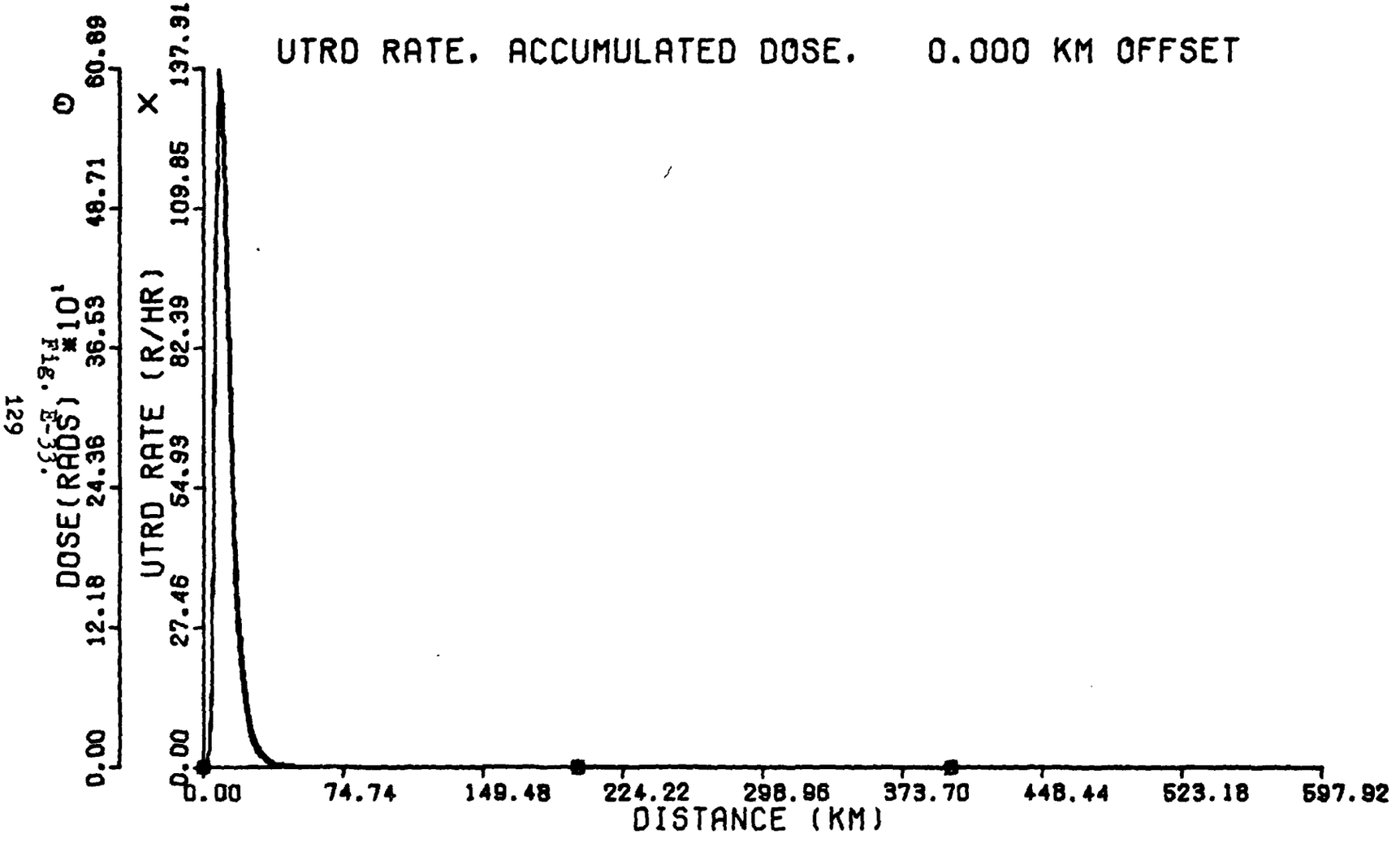

UTRD RATE, ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR)
0.00
12.18
24.36
36.53
48.71
60.89
0.00
27.46
54.93
82.39
109.86
137.91
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. 3-33.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .77829E+00 PER HR, OCCURRED AT 1.083 HOURS

MAX UTRD RATE, 249.404 RADS/HR, OCCURRED AT 25.00 KM

MAX ACCUM DOSE, 803.542 RADS, OCCURRED AT 22.92 KM

ACCUMULATED DOSE OF 493.820 RADS OCCURRED AT 35.42 KM

ACCUMULATED DOSE OF 99.995 RADS OCCURRED AT 56.25 KM

UTRD RATE OF 86.865 RADS/HR OCCURRED AT 45.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.93
AT	5.333	HOURS, CUMULATIVE G(T) IS	1.00
AT	8.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	10.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	13.333	HOURS, CUMULATIVE G(T) IS	1.00
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-34

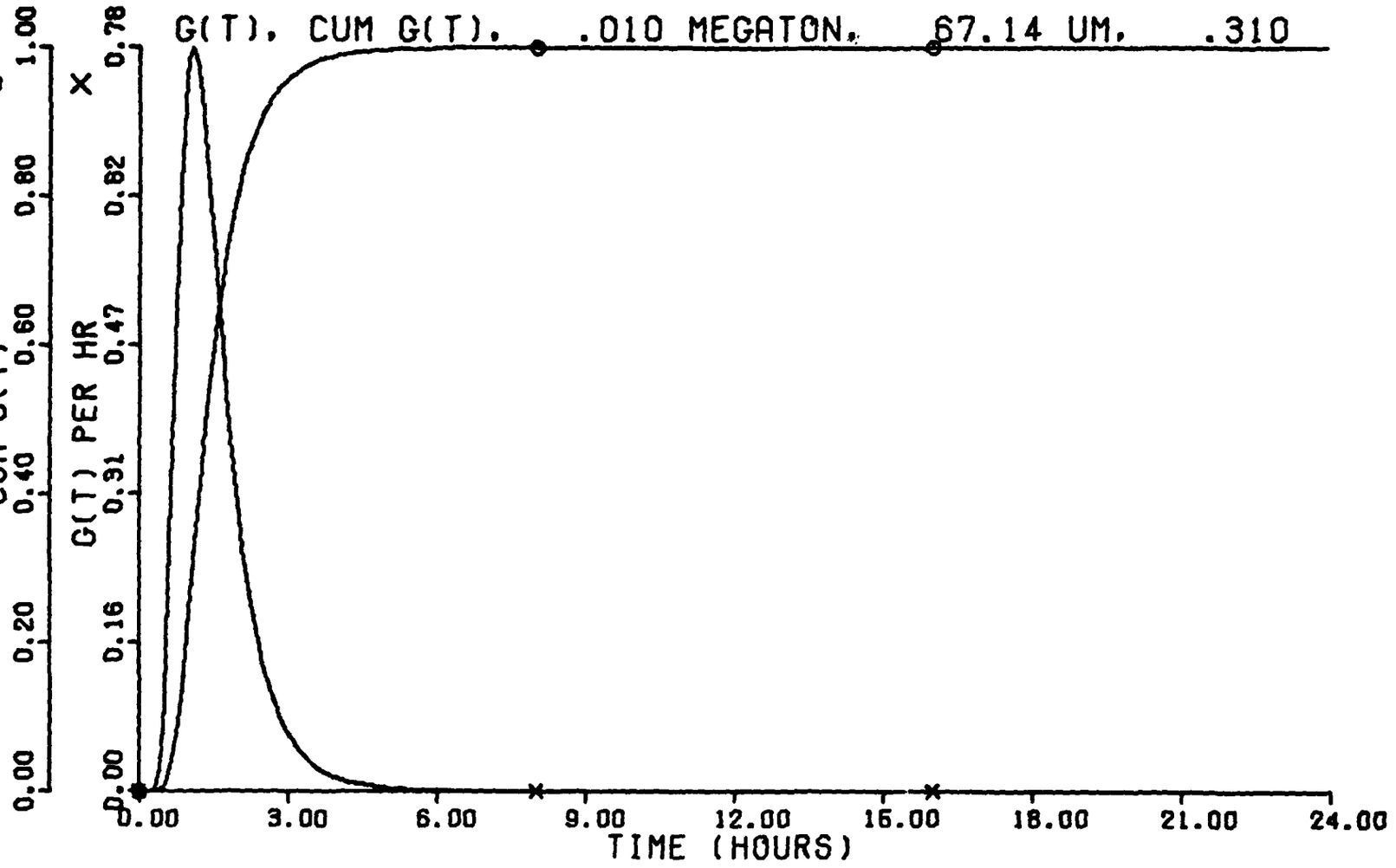

G(T), CUM G(T), .010 MEGATON, 67.14 UM, .310
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.16
0.31
0.47
0.62
0.78
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-35.

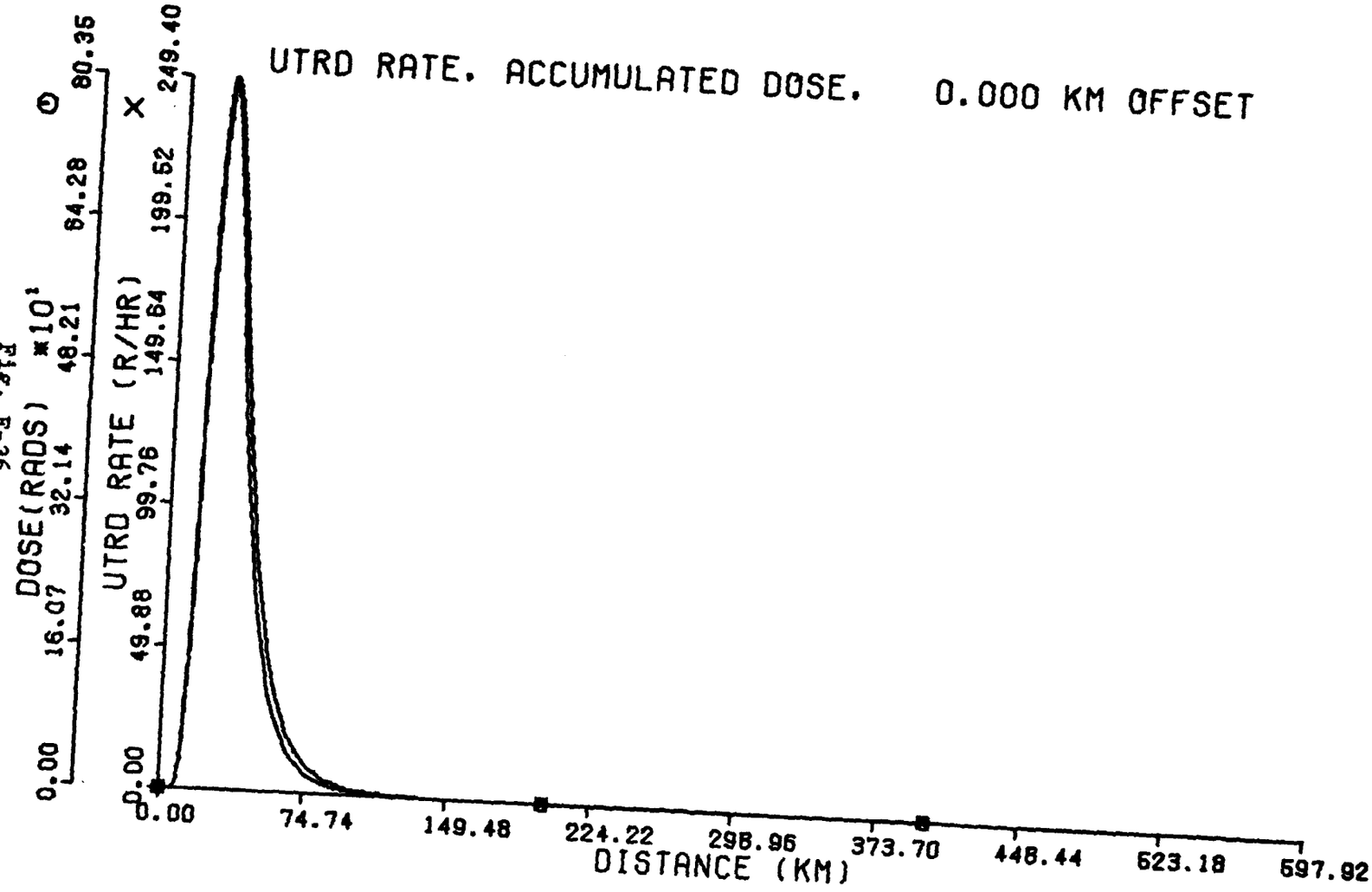

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) ×10¹
0.00
16.07
32.14
48.21
64.28
80.35
Θ
UTRD RATE (R/HR)
0.00
49.88
99.76
149.64
199.52
249.40
X
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. E-36. 132

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .37518E+00 PER HR, OCCURRED AT 2.167 HOURS

MAX UTRD RATE, 416.320 RADS/HR, OCCURRED AT 50.00 KM

MAX ACCUM DOSE, 1078.157 RADS, OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 970.324 RADS OCCURRED AT 56.25 KM

ACCUMULATED DOSE OF 474.972 RADS OCCURRED AT 79.17 KM

ACCUMULATED DOSE OF 98.095 RADS OCCURRED AT 118.75 KM

UTRD RATE OF 282.971 RADS/HR OCCURRED AT 70.83 KM

UTRD RATE OF 97.086 RADS/HR OCCURRED AT 102.08 KM

SELECTED CUMULATIVE G(T) DATA

AT 0.000 HOURS, CUMULATIVE G(T) IS 0.00
AT 2.667 HOURS, CUMULATIVE G(T) IS .47
AT 5.333 HOURS, CUMULATIVE G(T) IS .92
AT 8.000 HOURS, CUMULATIVE G(T) IS .99
AT 10.667 HOURS, CUMULATIVE G(T) IS 1.00
AT 13.333 HOURS, CUMULATIVE G(T) IS 1.00
AT 16.000 HOURS, CUMULATIVE G(T) IS 1.00
AT 18.667 HOURS, CUMULATIVE G(T) IS 1.00
AT 21.333 HOURS, CUMULATIVE G(T) IS 1.00

Fig. E-37.

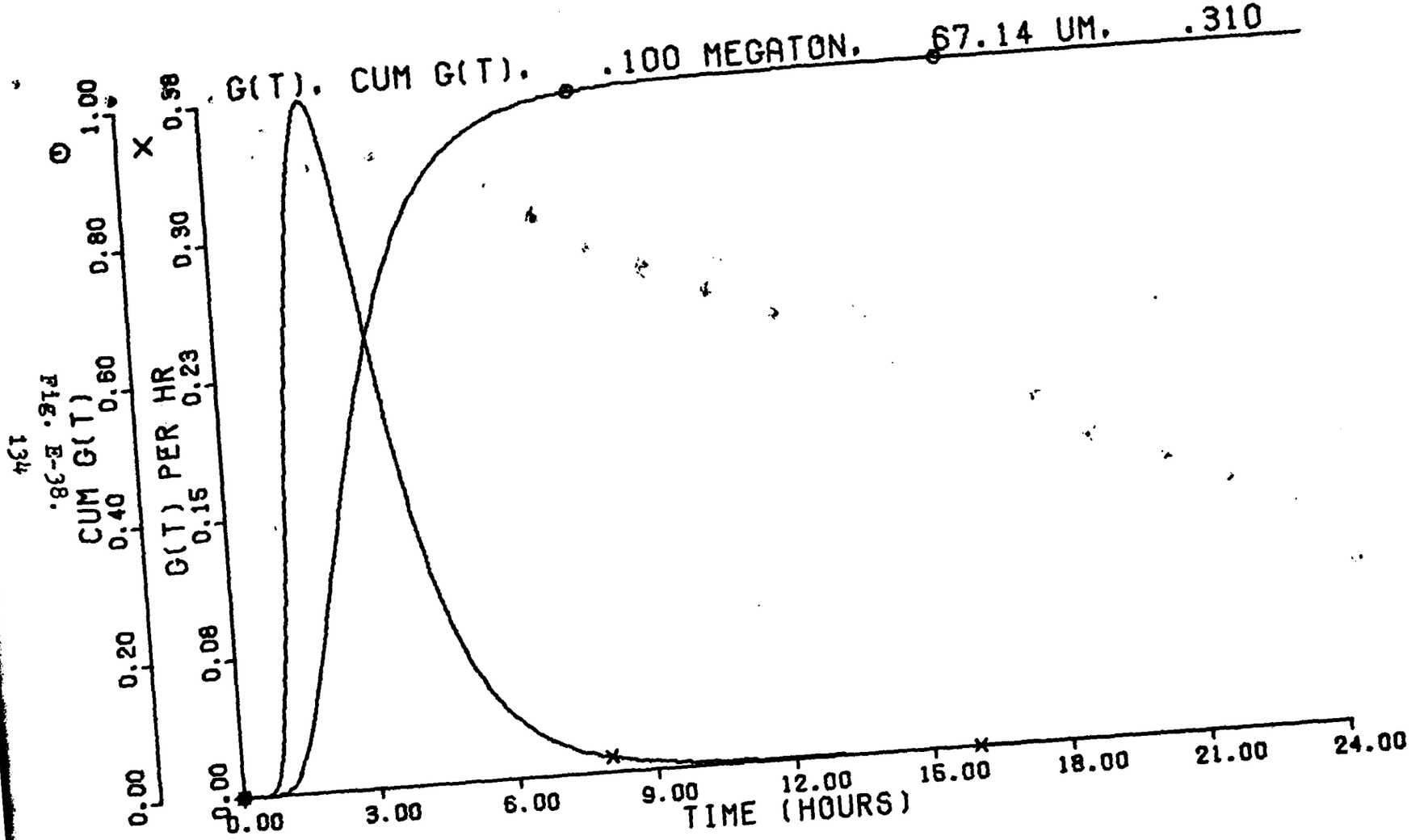
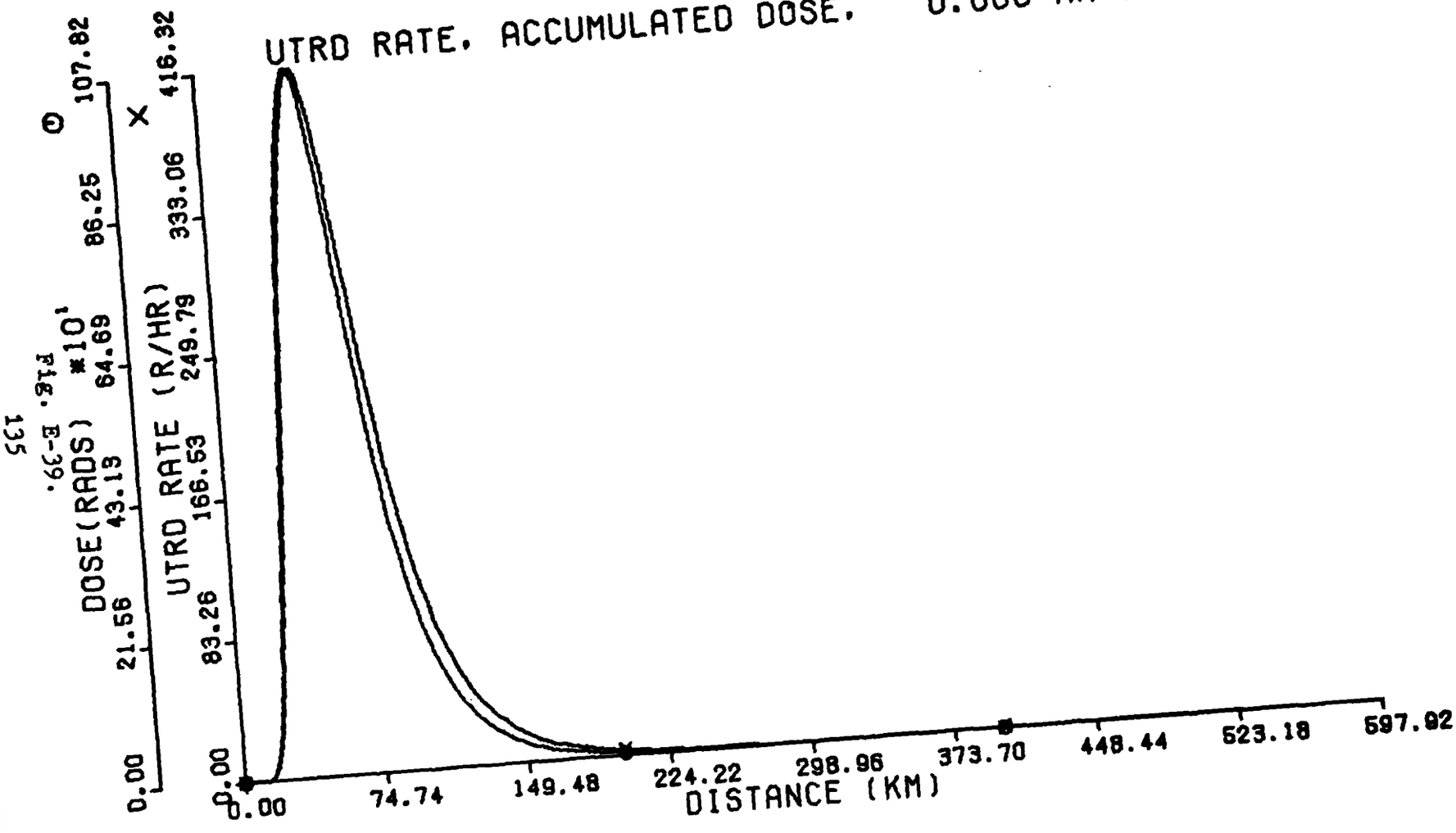

G(T), CUM G(T), .100 MEGATON, 67.14 UM, .310
Θ
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.08
0.15
0.23
0.30
0.38
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

FIG. E-38.


UTRD RATE, ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR)
DISTANCE (KM)
0.00
21.56
43.13
64.69
86.25
107.82
0.00
83.26
166.53
249.79
333.06
416.32
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .18098E+00 PER HR, OCCURRED AT 4.250 HOURS

MAX UTRD RATE, 5093.418 RADS/HR, OCCURRED AT 93.75 KM

MAX ACCUM DOSE, 10550.930 RADS, OCCURRED AT 87.50 KM

ACCUMULATED DOSE OF 986.590 RADS OCCURRED AT 229.17 KM

ACCUMULATED DOSE OF 491.487 RADS OCCURRED AT 264.58 KM

ACCUMULATED DOSE OF 97.996 RADS OCCURRED AT 352.08 KM

UTRD RATE OF 2996.766 RADS/HR OCCURRED AT 145.83 KM

UTRD RATE OF 977.066 RADS/HR OCCURRED AT 210.42 KM

UTRD RATE OF 298.177 RADS/HR OCCURRED AT 277.08 KM

UTRD RATE OF 97.327 RADS/HR OCCURRED AT 343.75 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.06
AT	5.333	HOURS, CUMULATIVE G(T) IS	.48
AT	7.917	HOURS, CUMULATIVE G(T) IS	.78
AT	10.500	HOURS, CUMULATIVE G(T) IS	.91
AT	13.083	HOURS, CUMULATIVE G(T) IS	.96
AT	15.667	HOURS, CUMULATIVE G(T) IS	.98
AT	18.250	HOURS, CUMULATIVE G(T) IS	.99
AT	20.833	HOURS, CUMULATIVE G(T) IS	1.00
AT	23.417	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-40.

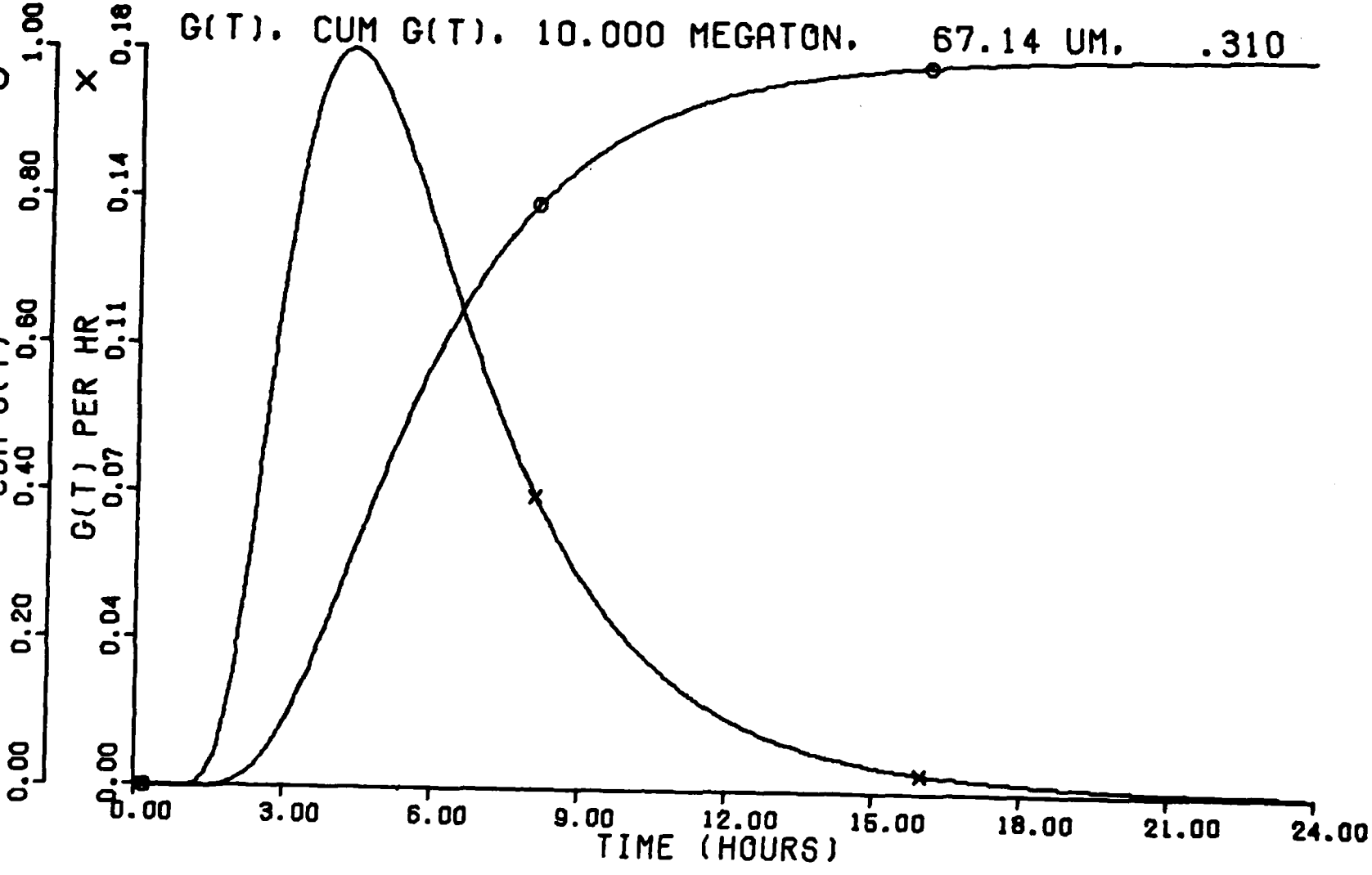
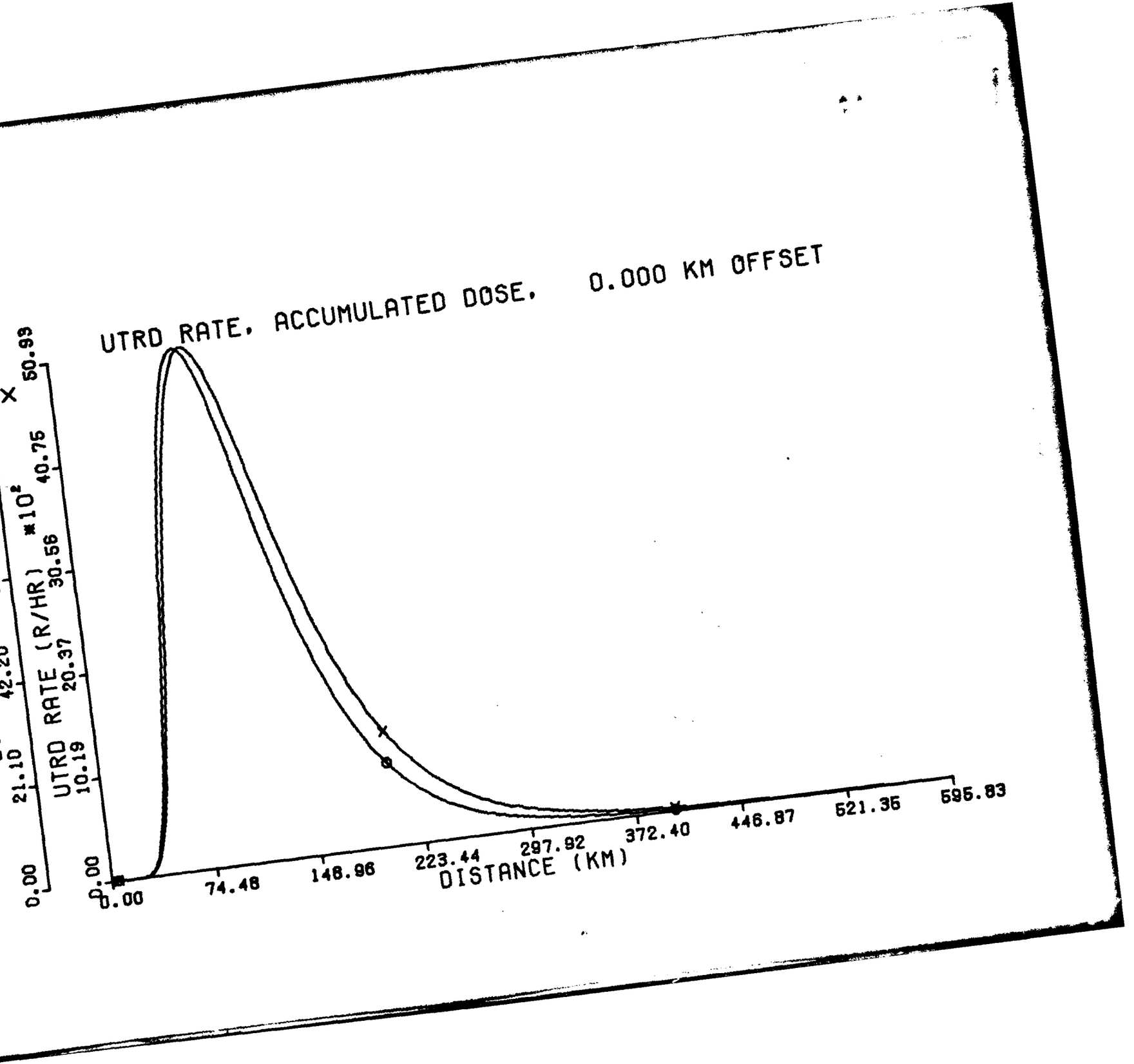

G(T). CUM G(T). 10.000 MEGATON. 67.14 UM. .310
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.04
0.07
0.11
0.14
0.18
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-41.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
UTRD RATE (R/HR)
DISTANCE (KM)
0.00
21.10
42.20
63.31
84.41
105.51
0.00
10.19
20.37
30.56
40.75
50.93
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
*10²
*10²
O
X

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE .31

MAX G(T), .16065E+00 PER HR, OCCURRED AT 4.750 HOURS

MAX UTRD RATE, 6400.230 RADS/HR, OCCURRED AT 104.17 KM

MAX ACCUM DOSE, 12726.960 RADS, OCCURRED AT 97.92 KM

ACCUMULATED DOSE OF 984.671 RADS OCCURRED AT 258.75 KM

ACCUMULATED DOSE OF 498.391 RADS OCCURRED AT 308.33 KM

ACCUMULATED DOSE OF 99.897 RADS OCCURRED AT 408.33 KM

UTRD RATE OF 2938.269 RADS/HR OCCURRED AT 181.25 KM

UTRD RATE OF 973.855 RADS/HR OCCURRED AT 252.08 KM

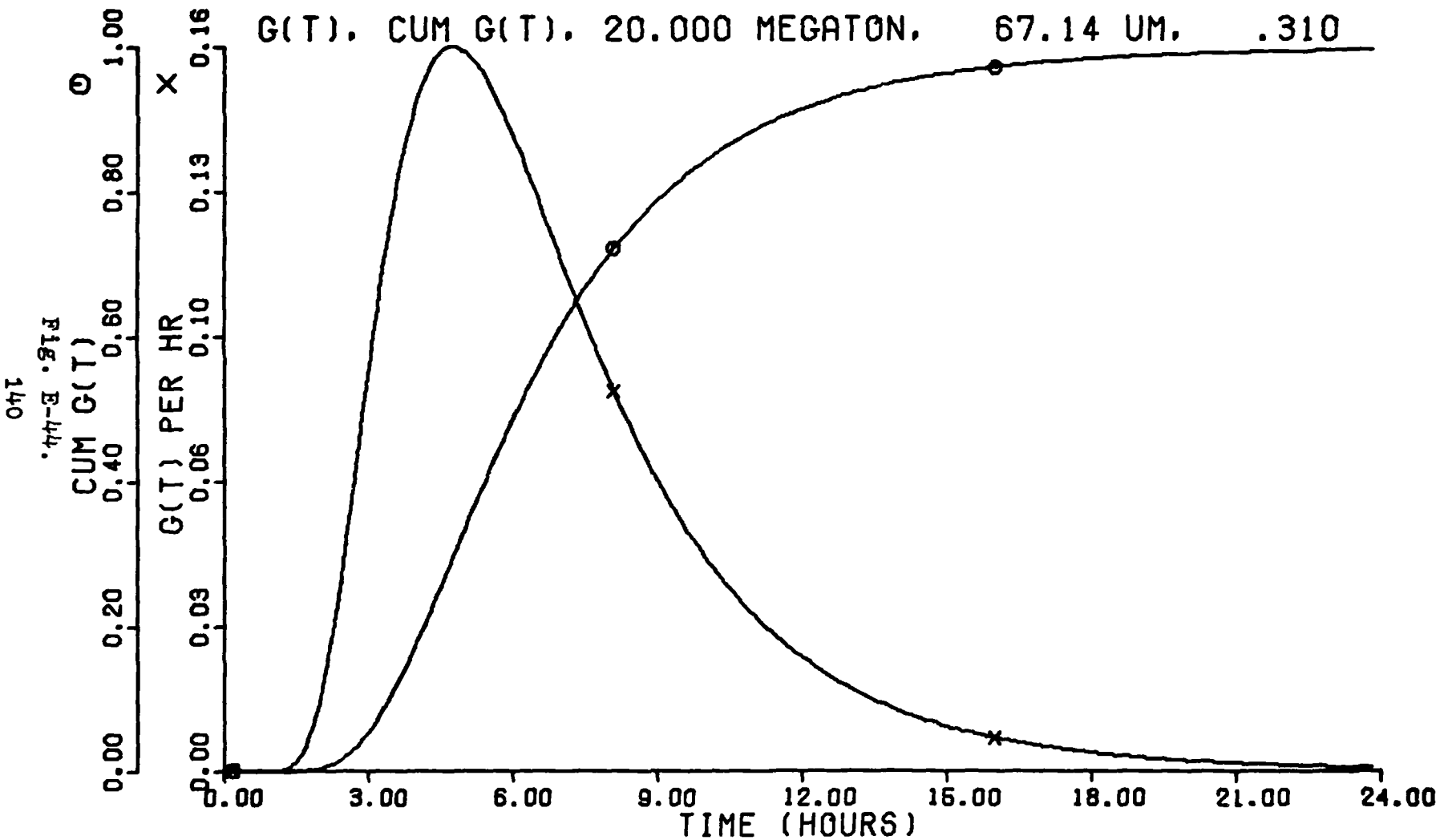
UTRD RATE OF 295.164 RADS/HR OCCURRED AT 329.17 KM

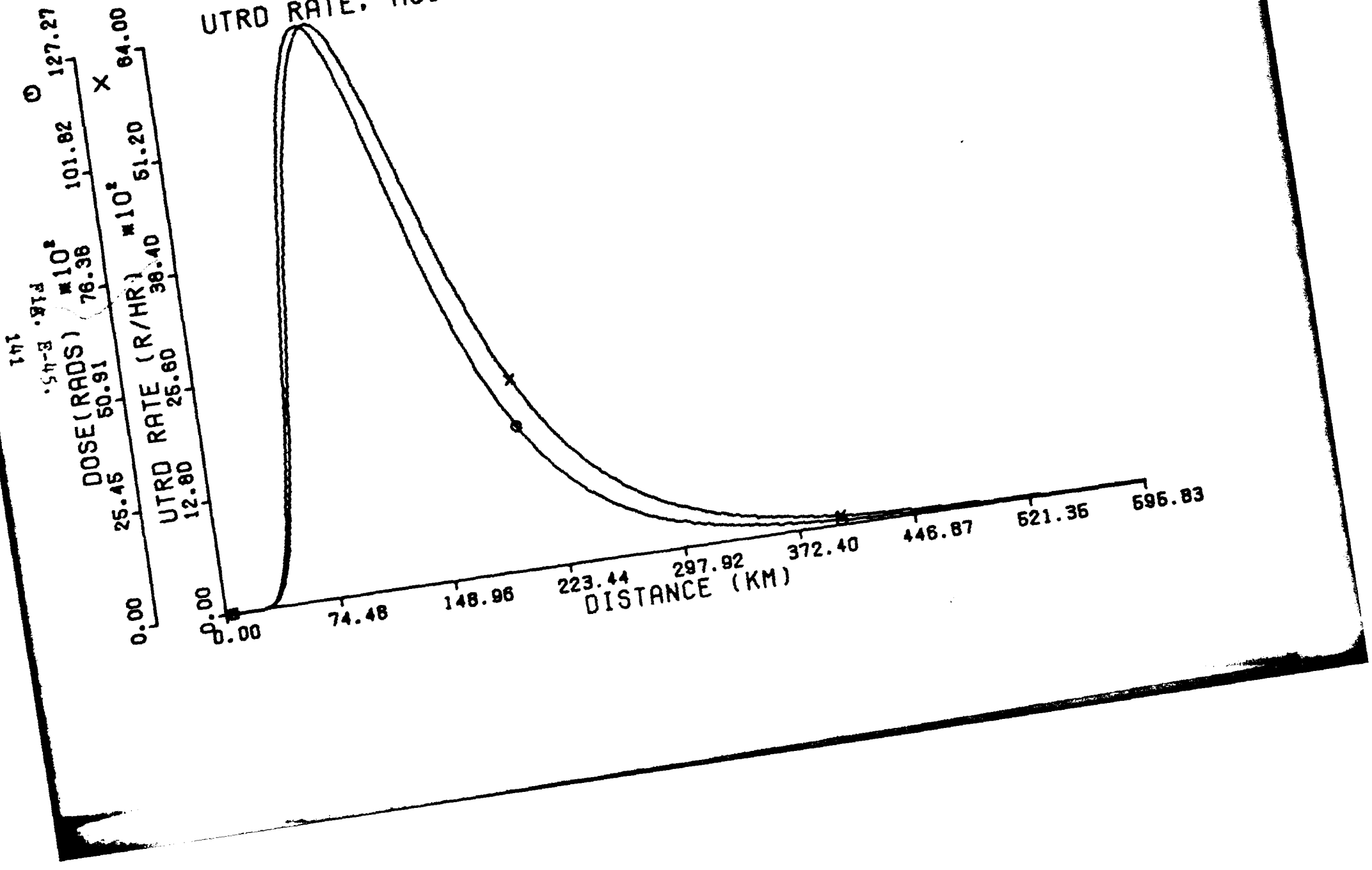
UTRD RATE OF 99.364 RADS/HR OCCURRED AT 404.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.03
AT	5.333	HOURS, CUMULATIVE G(T) IS	.39
AT	7.917	HOURS, CUMULATIVE G(T) IS	.71
AT	10.500	HOURS, CUMULATIVE G(T) IS	.87
AT	13.083	HOURS, CUMULATIVE G(T) IS	.94
AT	15.667	HOURS, CUMULATIVE G(T) IS	.97
AT	18.250	HOURS, CUMULATIVE G(T) IS	.99
AT	20.833	HOURS, CUMULATIVE G(T) IS	.99
AT	23.417	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-43


G(T). CUM G(T). 20.000 MEGATON. 67.14 UM. .310
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.03
0.06
0.10
0.13
0.16
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
0.00
25.45
50.91
76.36
101.82
127.27
UTRD RATE (R/HR)
0.00
12.80
25.60
38.40
51.20
64.00
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .41 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .20971E+01 PER HR, OCCURRED AT .083 HOURS

MAX UTRD RATE, 204.280 RADS/HR, OCCURRED AT 2.08 KM

MAX ACCUM DOSE, 1312.375 RADS, OCCURRED AT 2.08 KM

ACCUMULATED DOSE OF 556.630 RADS OCCURRED AT 4.17 KM

ACCUMULATED DOSE OF 289.941 RADS OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 81.918 RADS OCCURRED AT 12.50 KM

UTRD RATE OF 60.364 RADS/HR OCCURRED AT 6.25 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.71
AT	5.333	HOURS, CUMULATIVE G(T) IS	.79
AT	8.000	HOURS, CUMULATIVE G(T) IS	.83
AT	10.667	HOURS, CUMULATIVE G(T) IS	.85
AT	13.333	HOURS, CUMULATIVE G(T) IS	.86
AT	16.000	HOURS, CUMULATIVE G(T) IS	.87
AT	18.667	HOURS, CUMULATIVE G(T) IS	.88
AT	21.333	HOURS, CUMULATIVE G(T) IS	.89

Fig. E-46.

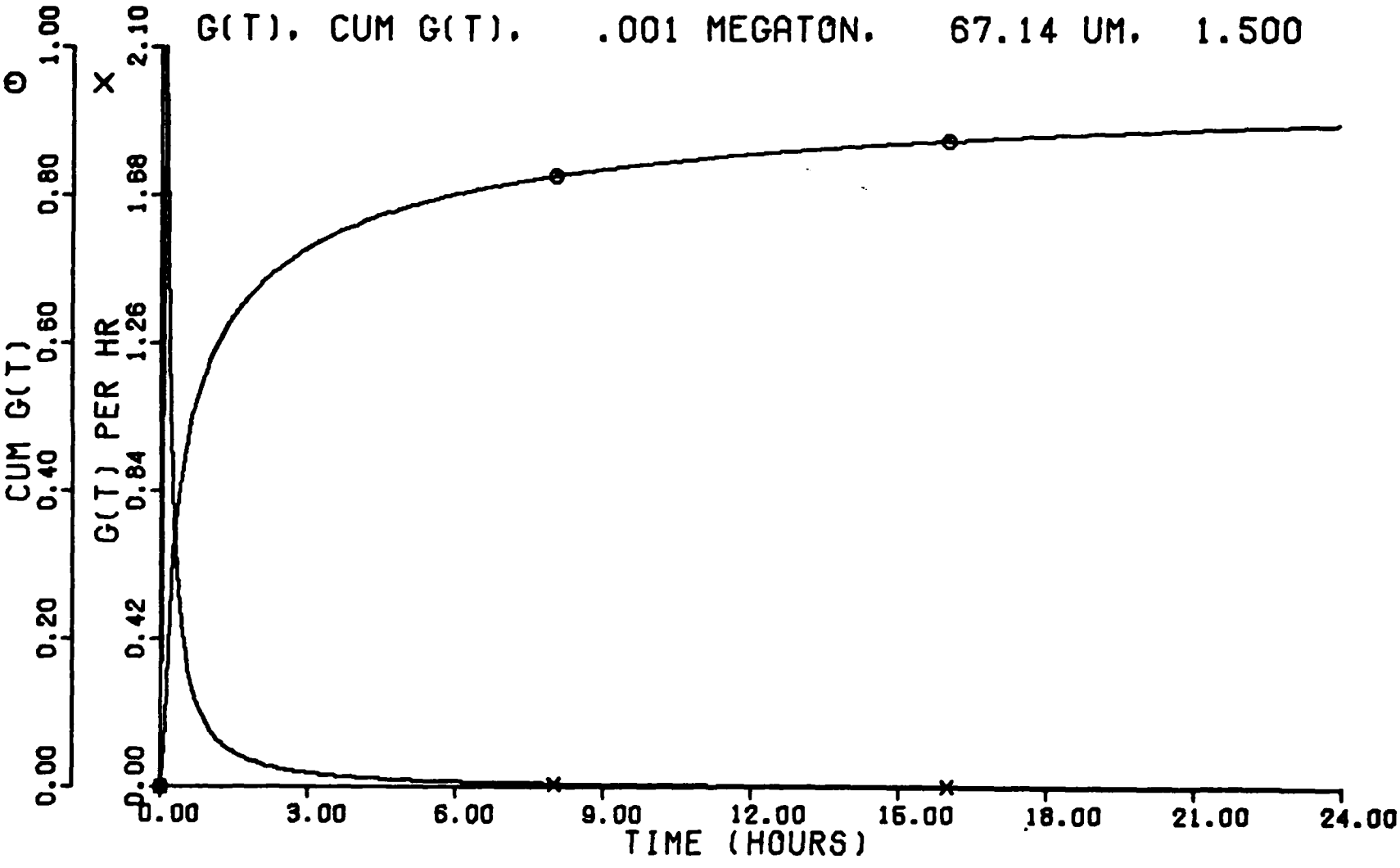
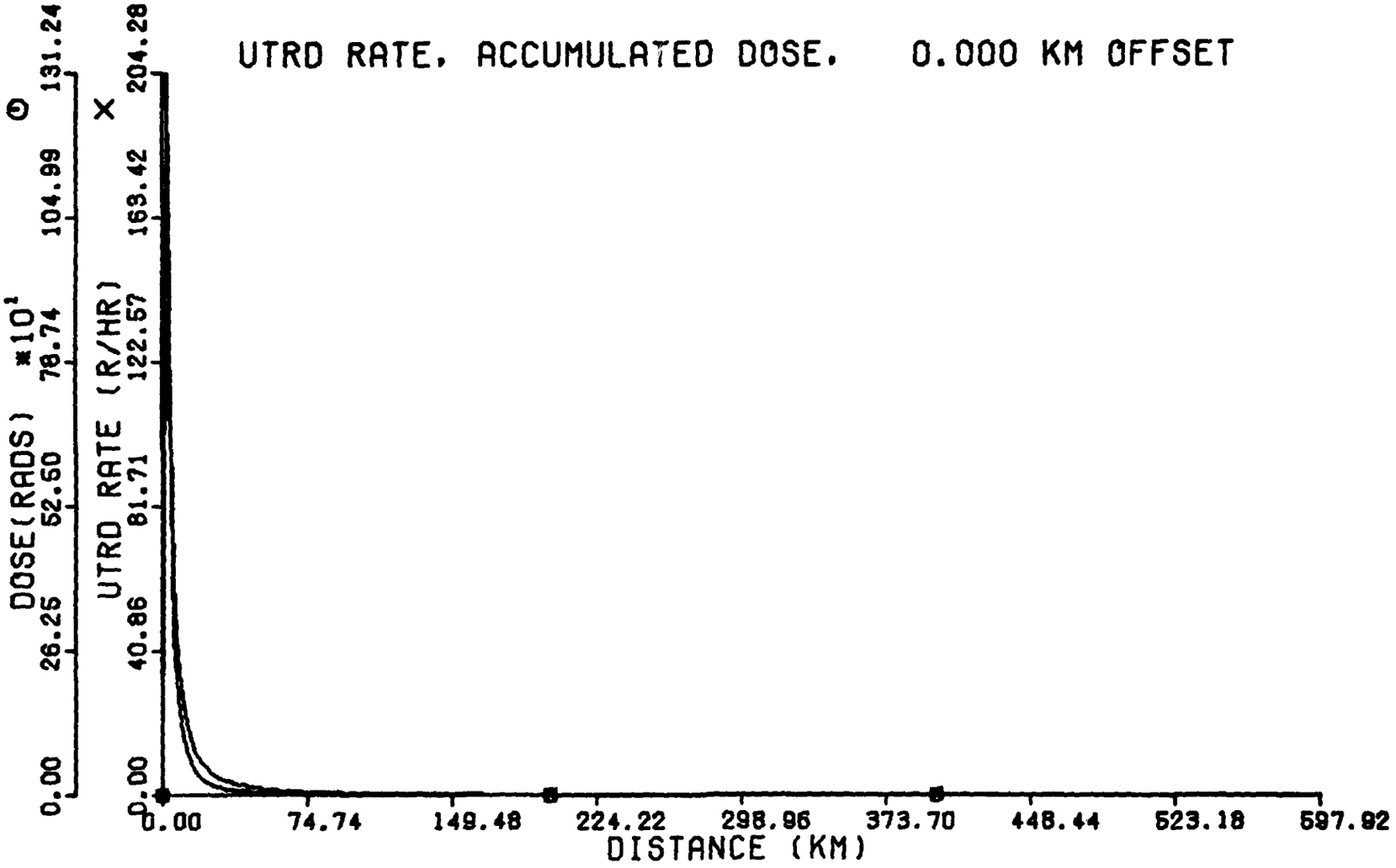

G(T). CUM G(T). .001 MEGATON. 67.14 UM. 1.500
O
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.42
0.84
1.26
1.68
2.10
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-47.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
0.00
26.25
52.50
78.74
104.99
131.24
UTRD RATE (R/HR)
0.00
40.86
81.71
122.57
163.42
204.28
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .84068E+00 PER HR, OCCURRED AT .167 HOURS

MAX UTRD RATE, 499.701 RADS/HR, OCCURRED AT 2.08 KM

MAX ACCUM DOSE, 3210.281 RADS, OCCURRED AT 2.08 KM

ACCUMULATED DOSE OF 955.978 RADS OCCURRED AT 10.42 KM

ACCUMULATED DOSE OF 443.417 RADS OCCURRED AT 16.67 KM

ACCUMULATED DOSE OF 91.283 RADS OCCURRED AT 37.50 KM

UTRD RATE OF 293.921 RADS/HR OCCURRED AT 8.33 KM

UTRD RATE OF 86.905 RADS/HR OCCURRED AT 20.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.63
AT	5.333	HOURS, CUMULATIVE G(T) IS	.73
AT	8.000	HOURS, CUMULATIVE G(T) IS	.78
AT	10.667	HOURS, CUMULATIVE G(T) IS	.81
AT	13.333	HOURS, CUMULATIVE G(T) IS	.84
AT	16.000	HOURS, CUMULATIVE G(T) IS	.85
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.88

Fig. E-49.

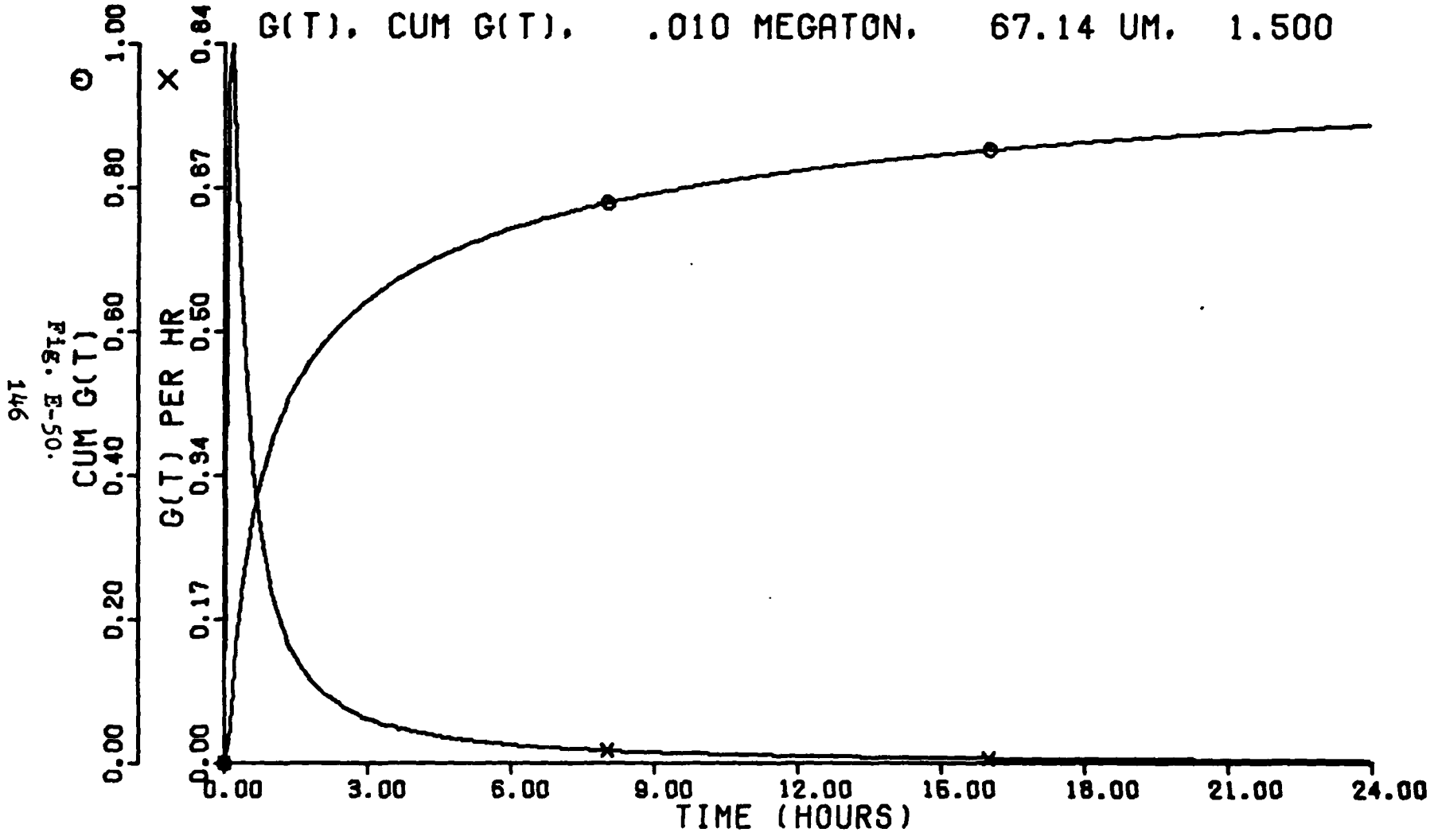

G(T), CUM G(T), .010 MEGATON, 67.14 UM, 1.500
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.17
0.34
0.50
0.67
0.84
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-50.

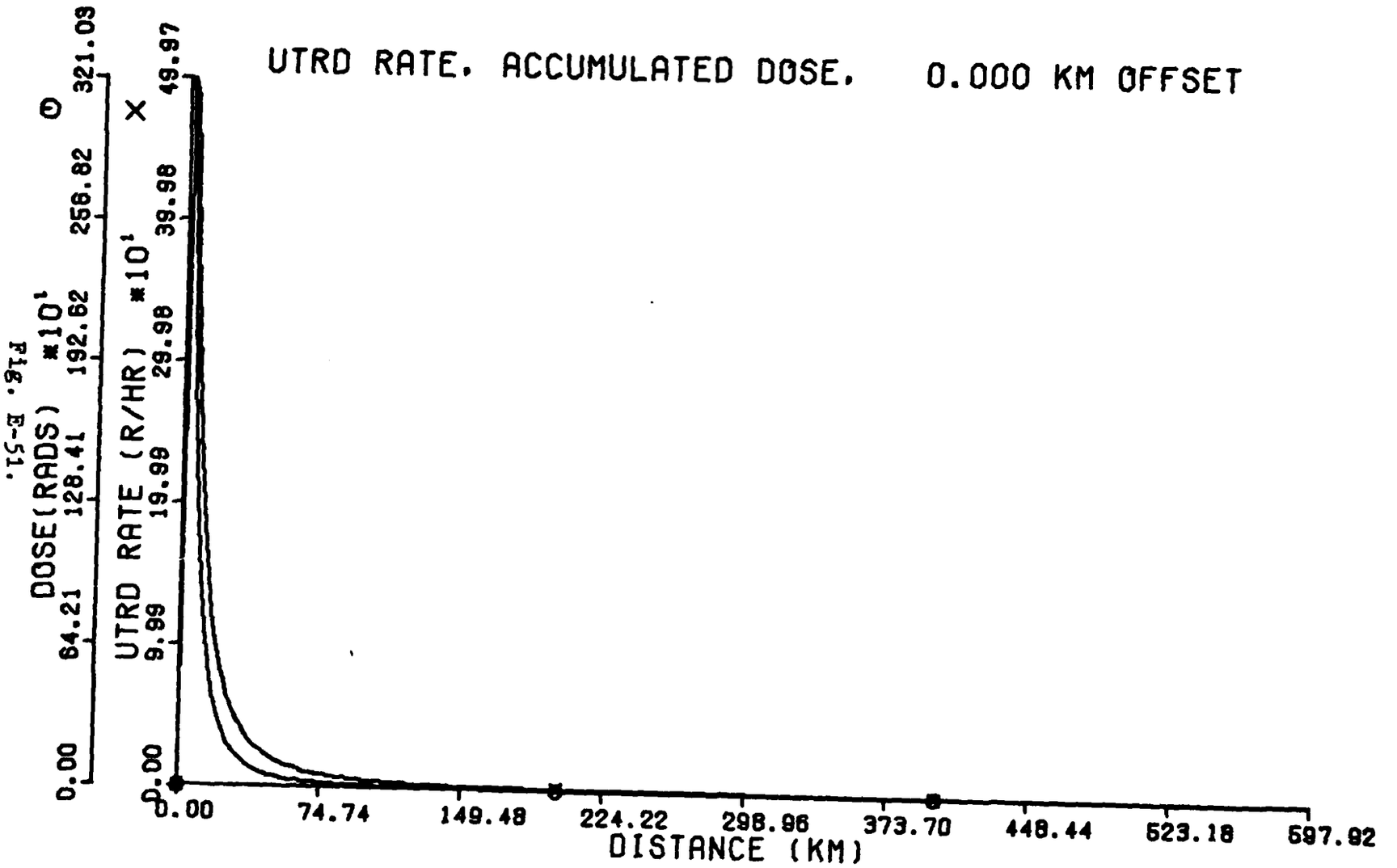

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10¹
0.00
64.21
128.41
192.62
256.82
321.03
UTRD RATE (R/HR) *10¹
0.00
9.99
19.99
29.98
39.98
49.97
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. E-51.

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .43496E+00 PER HR, OCCURRED AT .25) HOURS

MAX UTRD RATE, 1070.274 RADS/HR, OCCURRED AT 6.25 KM

MAX ACCUM DOSE, 5534.827 RADS, OCCURRED AT 4.17 KM

ACCUMULATED DOSE OF 955.646 RADS OCCURRED AT 27.08 KM

ACCUMULATED DOSE OF 464.101 RADS OCCURRED AT 39.58 KM

ACCUMULATED DOSE OF 96.971 RADS OCCURRED AT 81.25 KM

UTRD RATE OF 972.468 RADS/HR OCCURRED AT 8.33 KM

UTRD RATE OF 273.730 RADS/HR OCCURRED AT 29.17 KM

UTRD RATE OF 96.709 RADS/HR OCCURRED AT 54.17 KM

SELECTED CUMULATIVE G(T) DATA

AT 0.000 HOURS, CUMULATIVE G(T) IS 0.00
AT 2.667 HOURS, CUMULATIVE G(T) IS .49
AT 5.333 HOURS, CUMULATIVE G(T) IS .61
AT 8.000 HOURS, CUMULATIVE G(T) IS .67
AT 10.667 HOURS, CUMULATIVE G(T) IS .71
AT 13.333 HOURS, CUMULATIVE G(T) IS .74
AT 16.000 HOURS, CUMULATIVE G(T) IS .76
AT 18.667 HOURS, CUMULATIVE G(T) IS .78
AT 21.333 HOURS, CUMULATIVE G(T) IS .80

Fig. E-52.

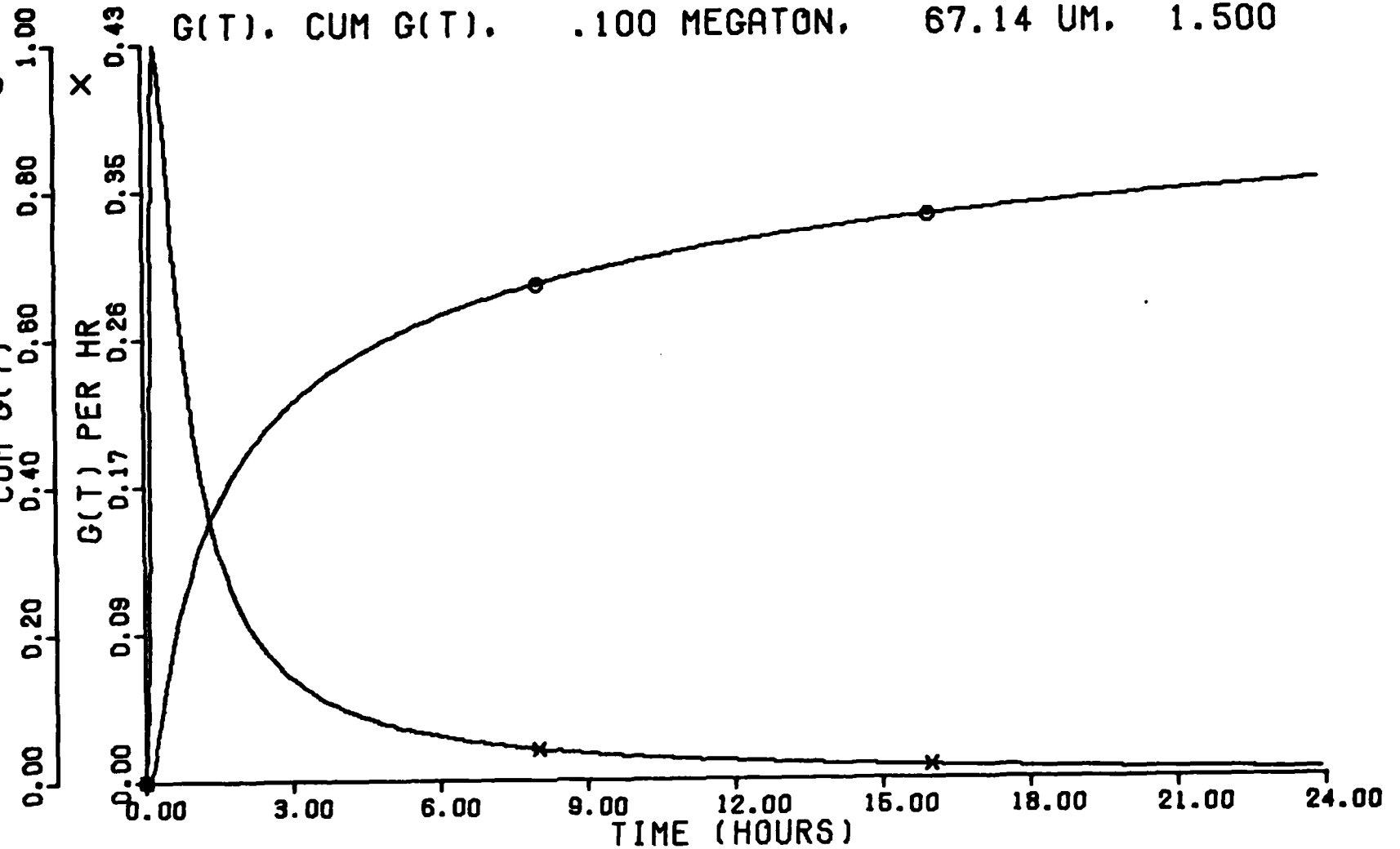

G(T). CUM G(T). .100 MEGATON. 67.14 UM. 1.500
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.09
0.17
0.26
0.35
0.43
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-53.

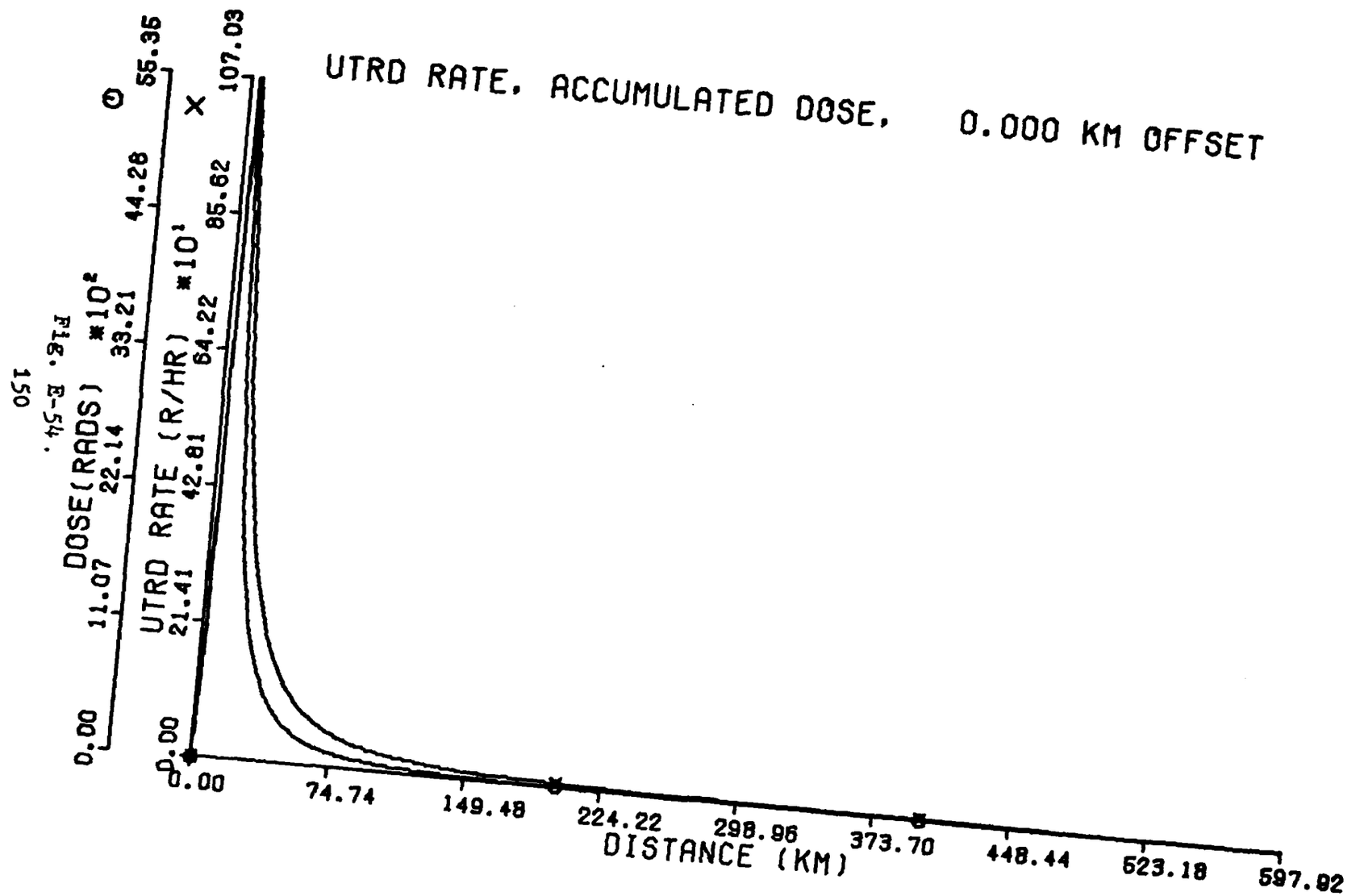

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
UTRD RATE (R/HR) *10²
*10¹
0.00
11.07
22.14
33.21
44.28
55.35
0.00
21.41
42.81
64.22
85.62
107.03
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

FIG. E-54.

150

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .23688E+00 PER HR, OCCURRED AT .417 HOURS

MAX UTRD RATE, 17845.225 RADS/HR, OCCURRED AT 8.33 KM

MAX ACCUM DOSE, 79131.093 RADS, OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 971.435 RADS OCCURRED AT 152.08 KM

ACCUMULATED DOSE OF 495.174 RADS OCCURRED AT 200.00 KM

ACCUMULATED DOSE OF 99.996 RADS OCCURRED AT 370.83 KM

UTRD RATE OF 2860.592 RADS/HR OCCURRED AT 64.58 KM

UTRD RATE OF 969.584 RADS/HR OCCURRED AT 116.67 KM

UTRD RATE OF 296.346 RADS/HR OCCURRED AT 213.42 KM

UTRD RATE OF 99.754 RADS/HR OCCURRED AT 352.08 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.36
AT	5.333	HOURS, CUMULATIVE G(T) IS	.48
AT	7.917	HOURS, CUMULATIVE G(T) IS	.55
AT	10.500	HOURS, CUMULATIVE G(T) IS	.60
AT	13.083	HOURS, CUMULATIVE G(T) IS	.63
AT	15.667	HOURS, CUMULATIVE G(T) IS	.66
AT	18.250	HOURS, CUMULATIVE G(T) IS	.68
AT	20.833	HOURS, CUMULATIVE G(T) IS	.70
AT	23.417	HOURS, CUMULATIVE G(T) IS	.71

Fig. E-55.

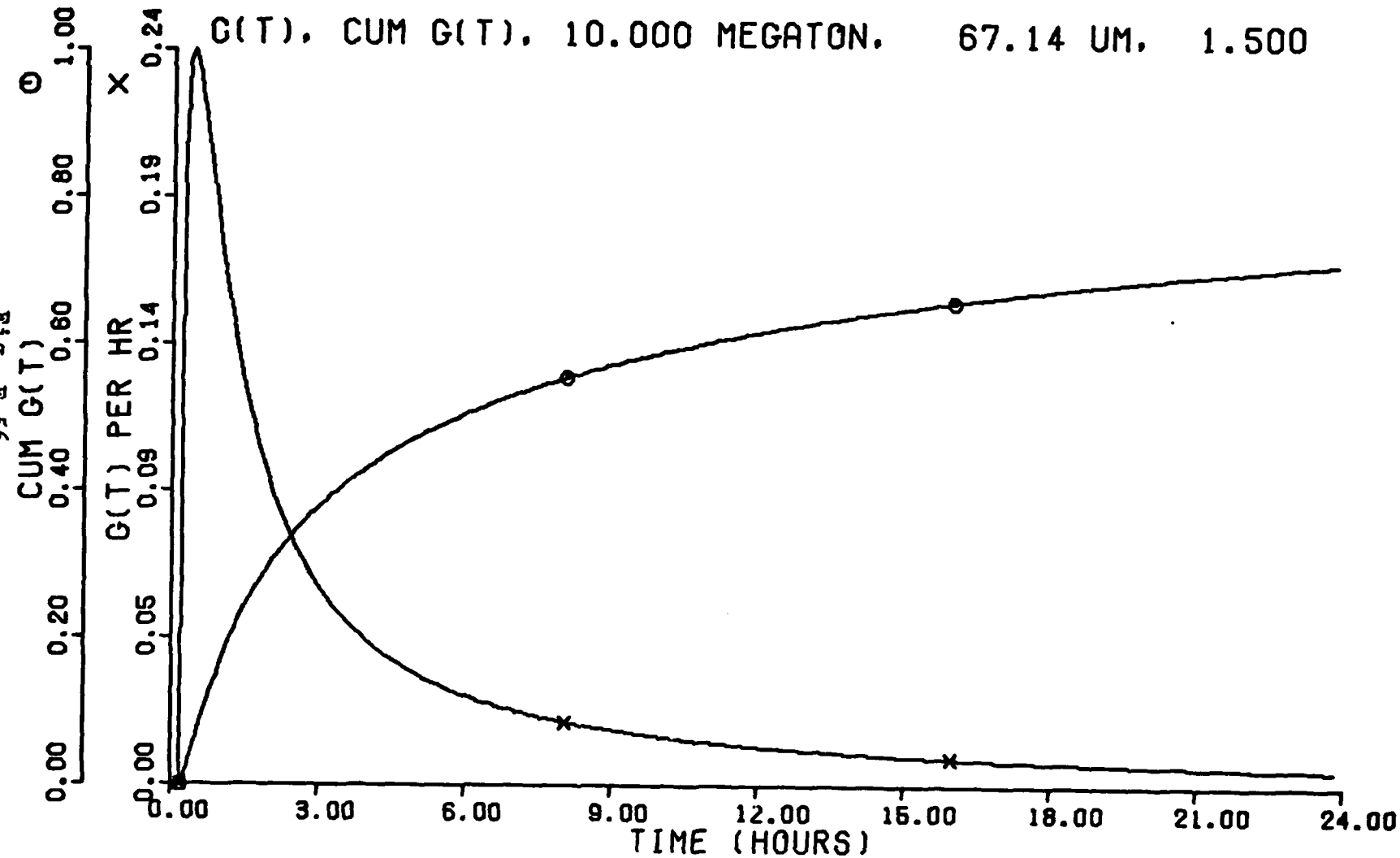
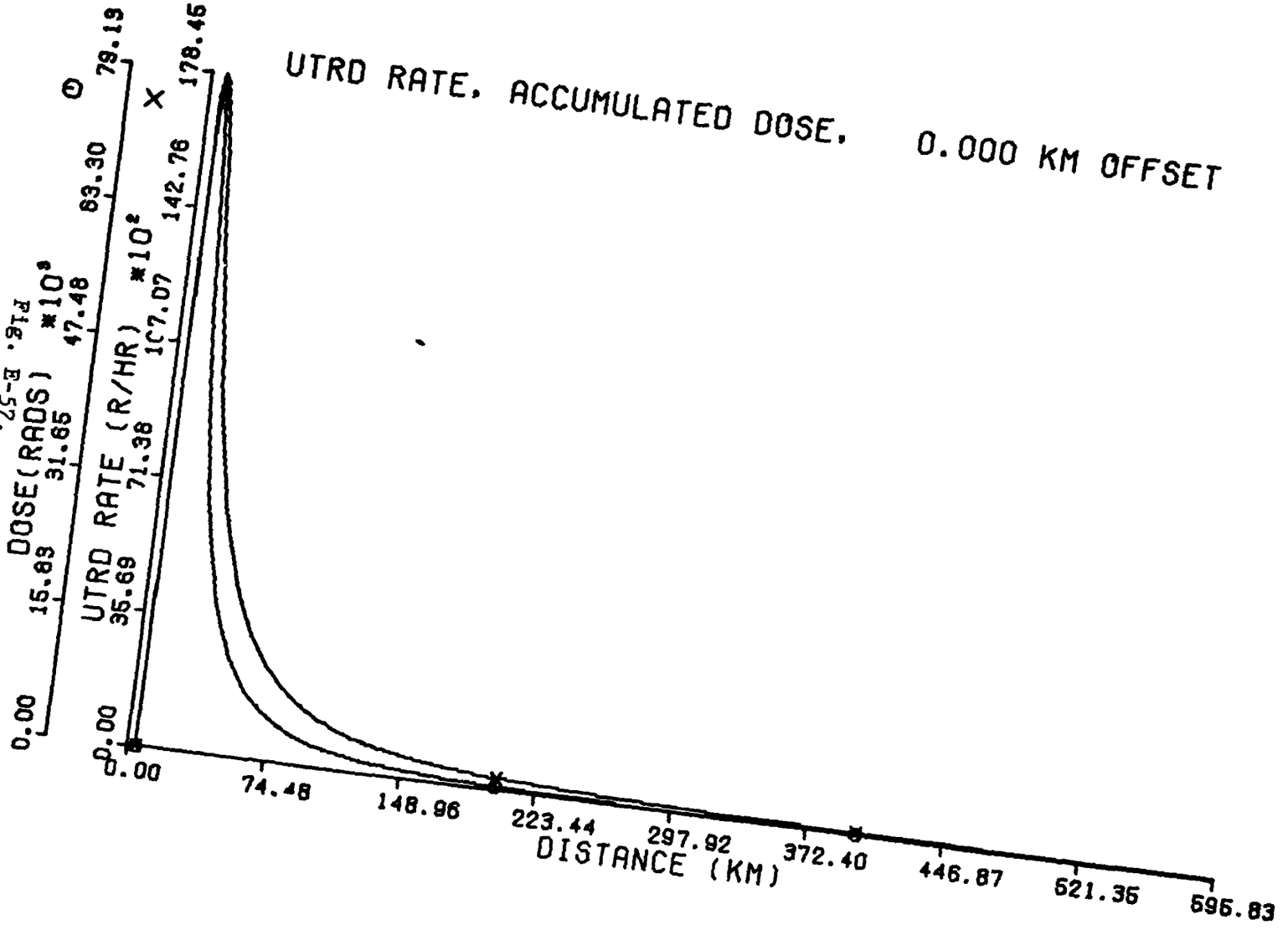

G(T), CUM G(T), 10.000 MEGATON, 67.14 UM, 1.500
O
X
CUM G(T)
G(T) PER HR
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.05
0.09
0.14
0.19
0.24
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
TIME (HOURS)

Fig. E-56.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
0.00
15.83
31.65
47.48
63.30
79.13
*10³
UTRD RATE (R/HR)
0.00
35.69
71.38
107.07
142.76
178.45
*10²
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)
Fig. E-57. 153

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 8.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 67.14 MICRONS, SLOPE 1.50

MAX G(T), .21900E+00 PER HR, OCCURRED AT .417 HOURS

MAX UTRD RATE, 21232.960 RADS/HR, OCCURRED AT 10.42 KM

MAX ACCUM DOSE, 93700.300 RADS, OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 988.551 RADS OCCURRED AT 183.33 KM

ACCUMULATED DOSE OF 492.670 RADS OCCURRED AT 243.75 KM

ACCUMULATED DOSE OF 99.090 RADS OCCURRED AT 452.08 KM

UTRD RATE OF 2961.601 RADS/HR OCCURRED AT 79.17 KM

UTRD RATE OF 985.545 RADS/HR OCCURRED AT 145.83 KM

UTRD RATE OF 297.938 RADS/HR OCCURRED AT 266.67 KM

UTRD RATE OF 99.288 RADS/HR OCCURRED AT 450.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.34
AT	5.333	HOURS, CUMULATIVE G(T) IS	.47
AT	7.917	HOURS, CUMULATIVE G(T) IS	.54
AT	10.500	HOURS, CUMULATIVE G(T) IS	.58
AT	13.083	HOURS, CUMULATIVE G(T) IS	.62
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.66
AT	20.833	HOURS, CUMULATIVE G(T) IS	.68
AT	23.417	HOURS, CUMULATIVE G(T) IS	.70

Fig. E-58.

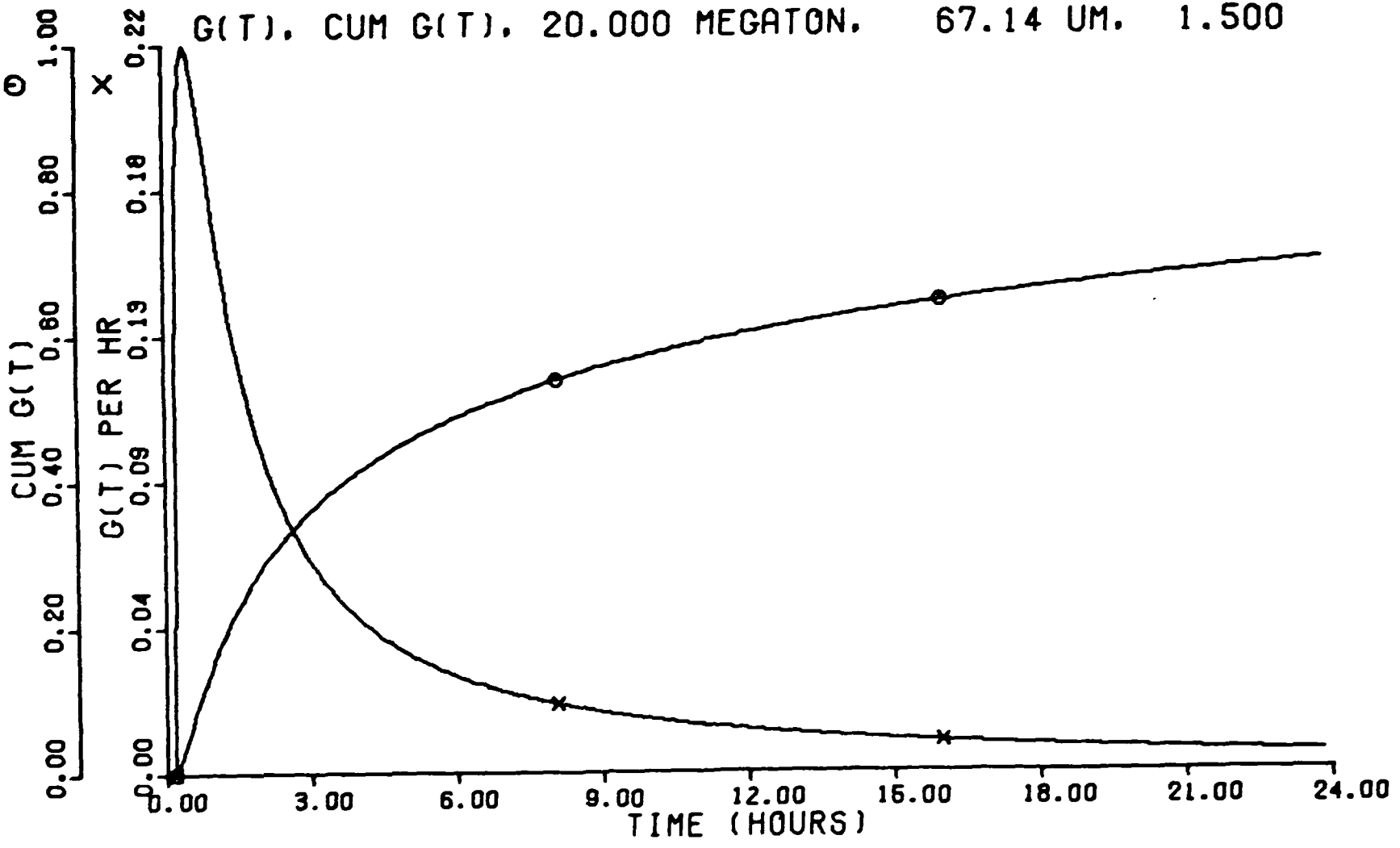

G(T), CUM G(T), 20.000 MEGATON, 67.14 UM, 1.500
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.04
0.09
0.13
0.18
0.22
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-59.

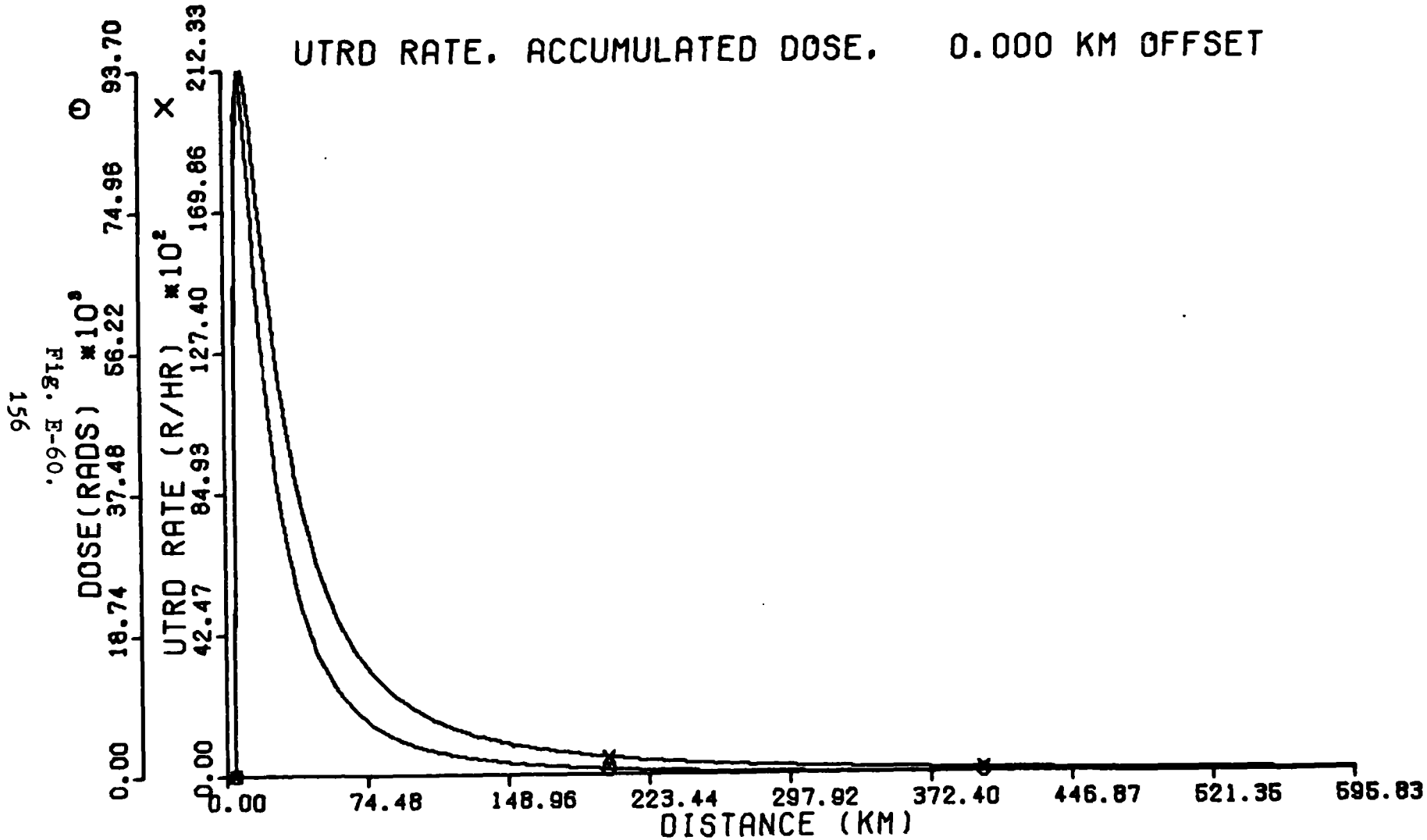

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *10³
0.00
18.74
37.48
56.22
74.96
93.70
UTRD RATE (R/HR) *10²
0.00
42.47
84.93
127.40
169.86
212.33
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. E-60.

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .41 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .30

MAX G(T), .38094E+01 PER HR, OCCURRED AT .783 HOURS

MAX UTRD RATE, 371.077 RADS/HR, OCCURRED AT 2.08 KM

MAX ACCUM DOSE, 2383.952 RADS, OCCURRED AT 2.08 KM

ACCUMULATED DOSE OF 495.280 RADS OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 495.280 RADS OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 97.170 RADS OCCURRED AT 12.50 KM

UTRD RATE OF 200.167 RADS/HR OCCURRED AT 4.17 KM

UTRD RATE OF 58.958 RADS/HR OCCURRED AT 8.33 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.97
AT	5.333	HOURS, CUMULATIVE G(T) IS	.99
AT	8.000	HOURS, CUMULATIVE G(T) IS	.99
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	.99
AT	18.667	HOURS, CUMULATIVE G(T) IS	.99
AT	21.333	HOURS, CUMULATIVE G(T) IS	.99

Fig. E-61.

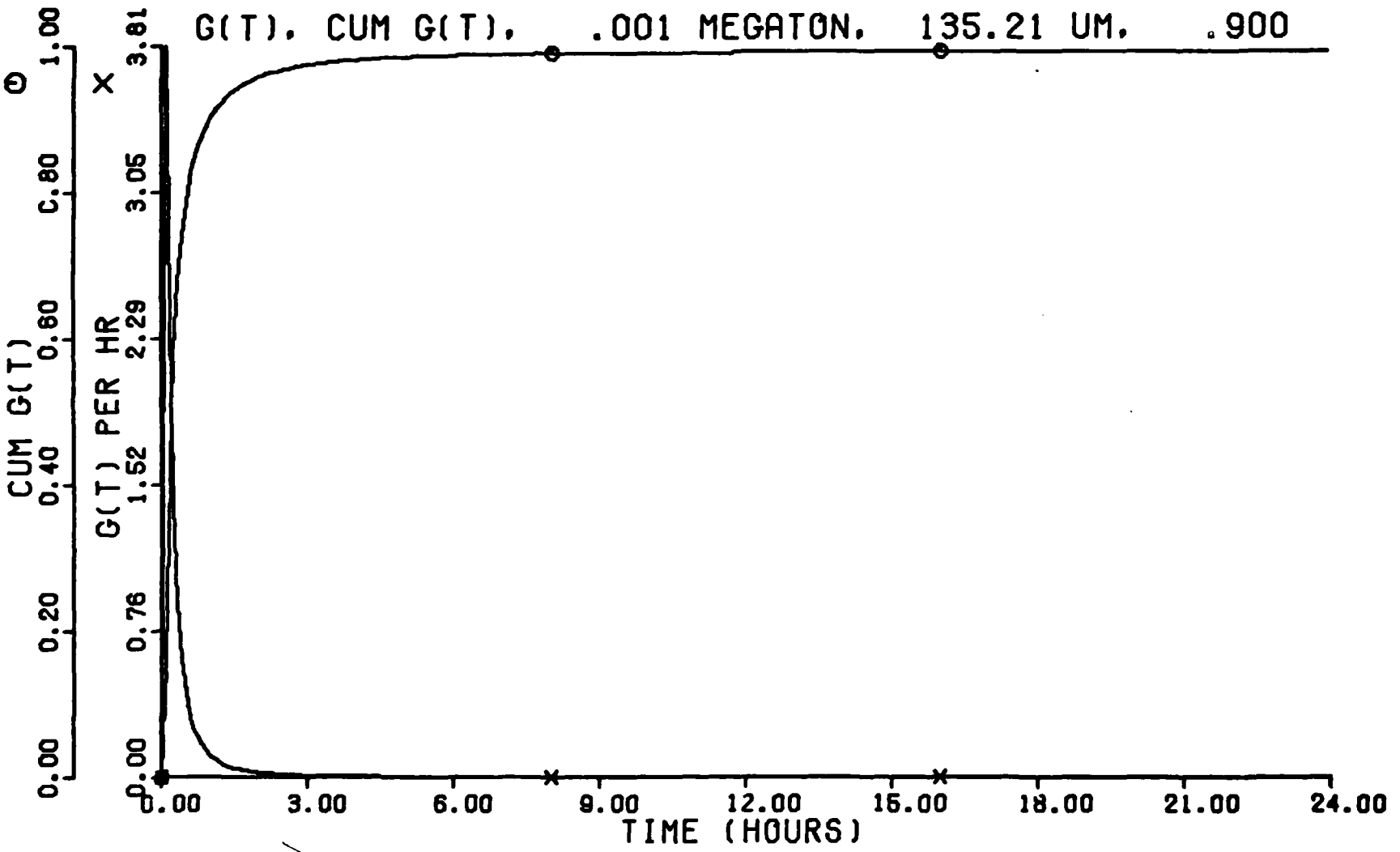

G(T), CUM G(T), .001 MEGATON, 135.21 UM, .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.76
1.52
2.29
3.05
3.81
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-62.

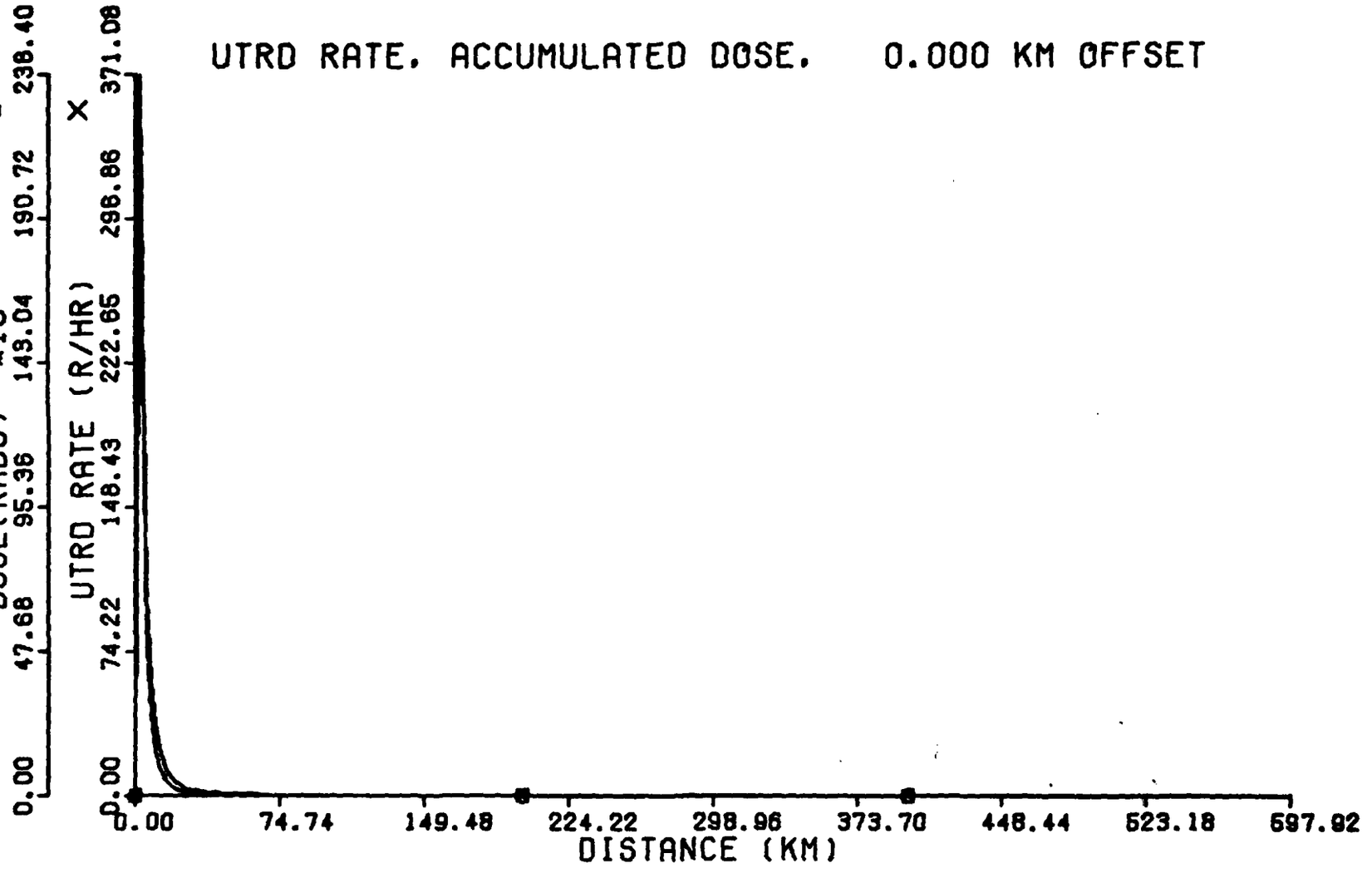

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS) *1C¹
0.00
47.68
95.36
143.04
190.72
238.40
Θ
UTRD RATE (R/HR)
0.00
74.22
148.43
222.65
296.86
371.08
X
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. E-63.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .90

MAX G(T), .13336E+01 PER HR, OCCURRED AT .250 HOURS

MAX UTRD RATE, 717.154 RADS/HR, OCCURRED AT 4.17 KM

MAX ACCUM DOSE, 3844.295 RADS, OCCURRED AT 4.17 KM

ACCUMULATED DOSE OF 774.996 RADS OCCURRED AT 16.67 KM

ACCUMULATED DOSE OF 469.381 RADS OCCURRED AT 20.83 KM

ACCUMULATED DOSE OF 90.286 RADS OCCURRED AT 39.58 KM

UTRD RATE OF 270.908 RADS/HR OCCURRED AT 14.58 KM

UTRD RATE OF 94.287 RADS/HR OCCURRED AT 25.00 KM

SELECTED CUMULATIVE G(T) DATA

AT 0.000 HOURS, CUMULATIVE G(T) IS 0.00
AT 2.667 HOURS, CUMULATIVE G(T) IS .90
AT 5.333 HOURS, CUMULATIVE G(T) IS .96
AT 8.000 HOURS, CUMULATIVE G(T) IS .98
AT 10.667 HOURS, CUMULATIVE G(T) IS .99
AT 13.333 HOURS, CUMULATIVE G(T) IS .99
AT 16.000 HOURS, CUMULATIVE G(T) IS .99
AT 18.667 HOURS, CUMULATIVE G(T) IS 1.00
AT 21.333 HOURS, CUMULATIVE G(T) IS 1.00

Fig. E-64.

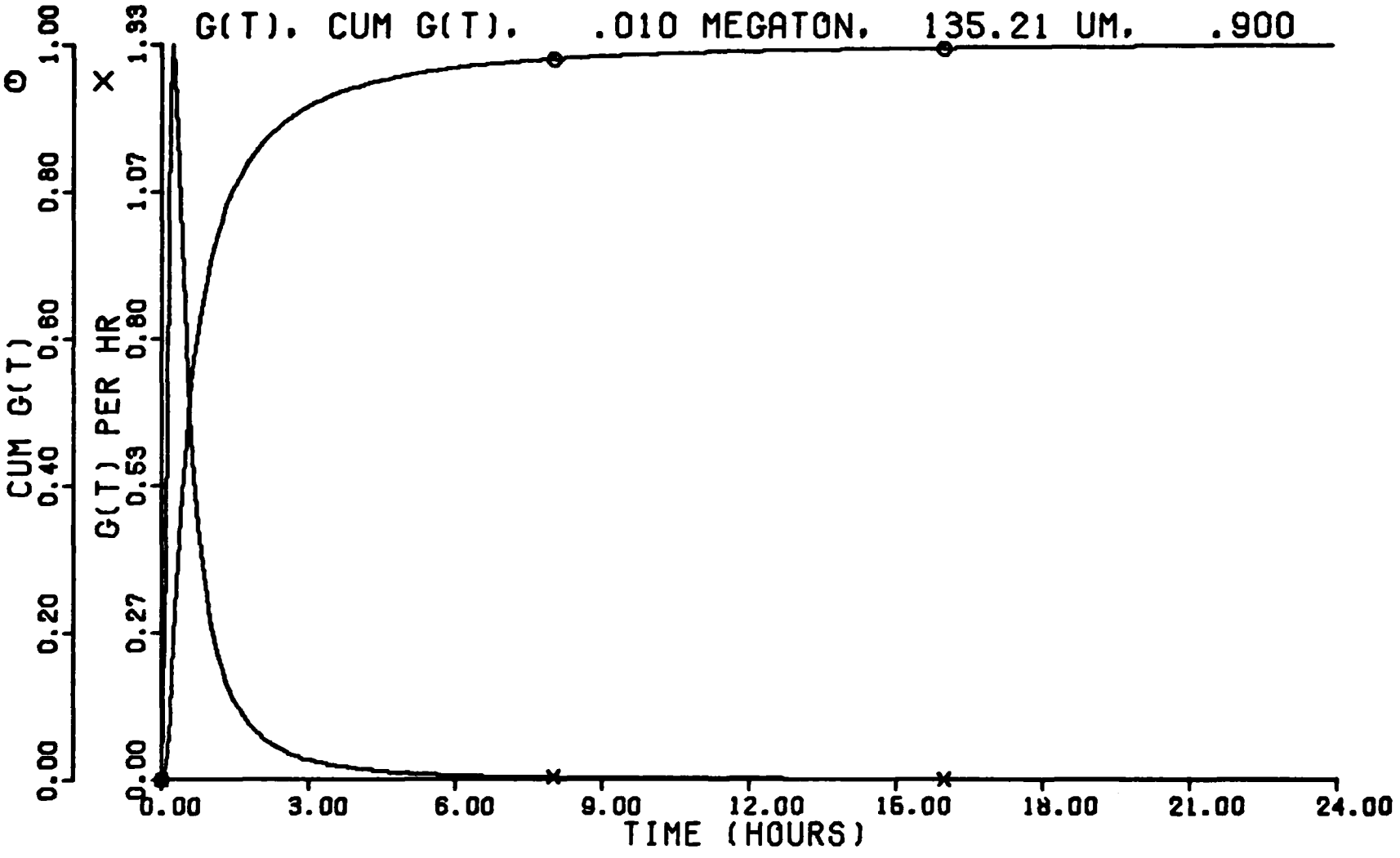
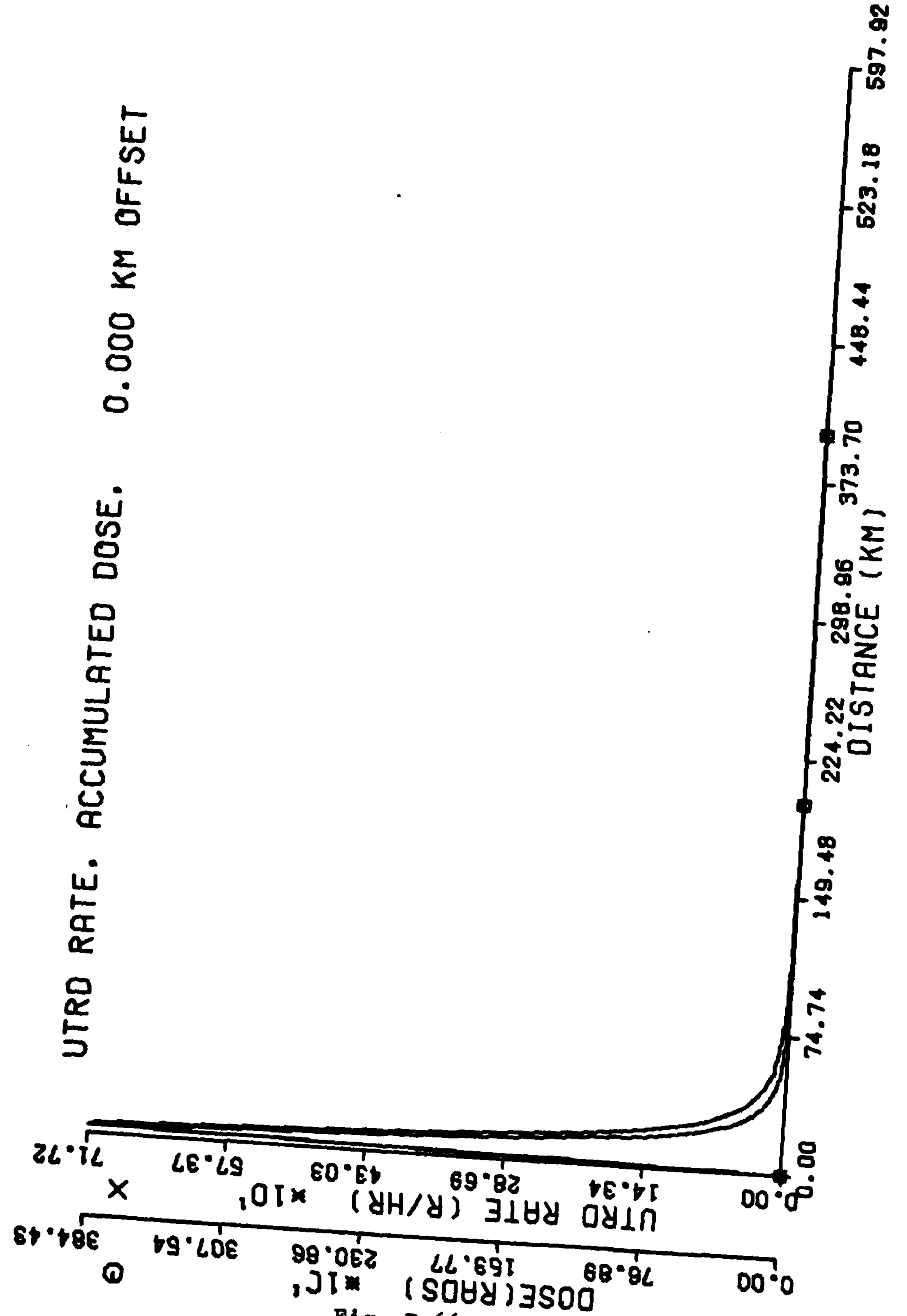

G(T). CUM G(T). .010 MEGATON. 135.21 UM. .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.27
0.53
0.80
1.07
1.33
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-65.



UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
UTRD RATE (R/HR) ×10¹
0.00
14.34
28.69
43.03
57.37
71.72
DOSE(RADS) ×10¹
0.00
76.89
153.77
230.66
307.54
384.43

Fig. E-66.

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .90

MAX G(T), .66453E+00 PER HR, OCCURRED AT .417 HOURS

MAX UTRD RATE, 1479.092 RADS/HR, OCCURRED AT 10.42 KM

MAX ACCUM DOSE, 6403.621 RADS, OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 993.907 RADS OCCURRED AT 35.42 KM

ACCUMULATED DOSE OF 470.024 RADS OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 99.719 RADS OCCURRED AT 63.33 KM

UTRD RATE OF 984.973 RADS/HR OCCURRED AT 18.75 KM

UTRD RATE OF 275.354 RADS/HR OCCURRED AT 39.58 KM

UTRD RATE OF 96.693 RADS/HR OCCURRED AT 62.50 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.77
AT	5.333	HOURS, CUMULATIVE G(T) IS	.90
AT	8.000	HOURS, CUMULATIVE G(T) IS	.94
AT	10.667	HOURS, CUMULATIVE G(T) IS	.96
AT	13.333	HOURS, CUMULATIVE G(T) IS	.97
AT	16.000	HOURS, CUMULATIVE G(T) IS	.98
AT	18.667	HOURS, CUMULATIVE G(T) IS	.98
AT	21.333	HOURS, CUMULATIVE G(T) IS	.99

Fig. E-67.

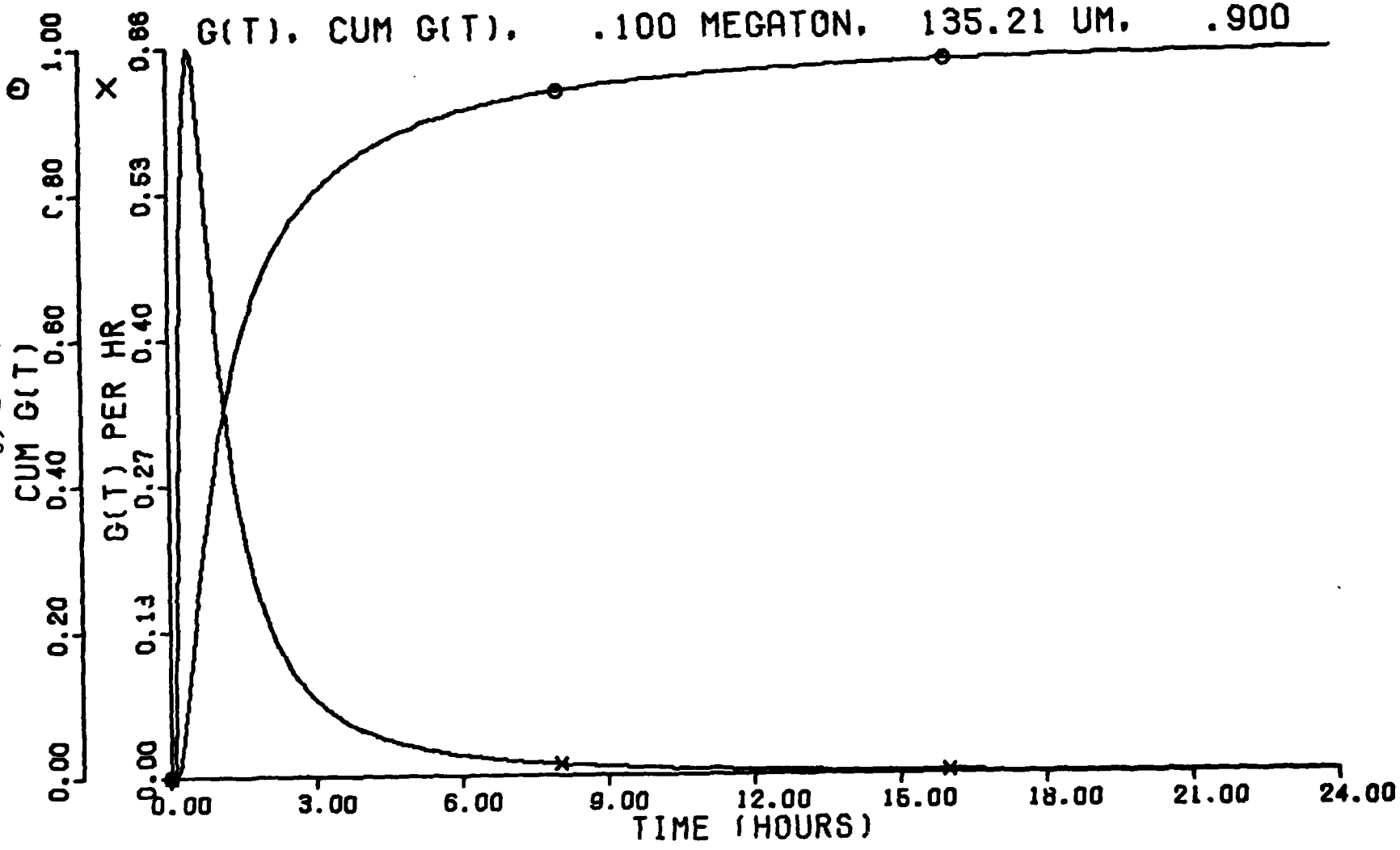
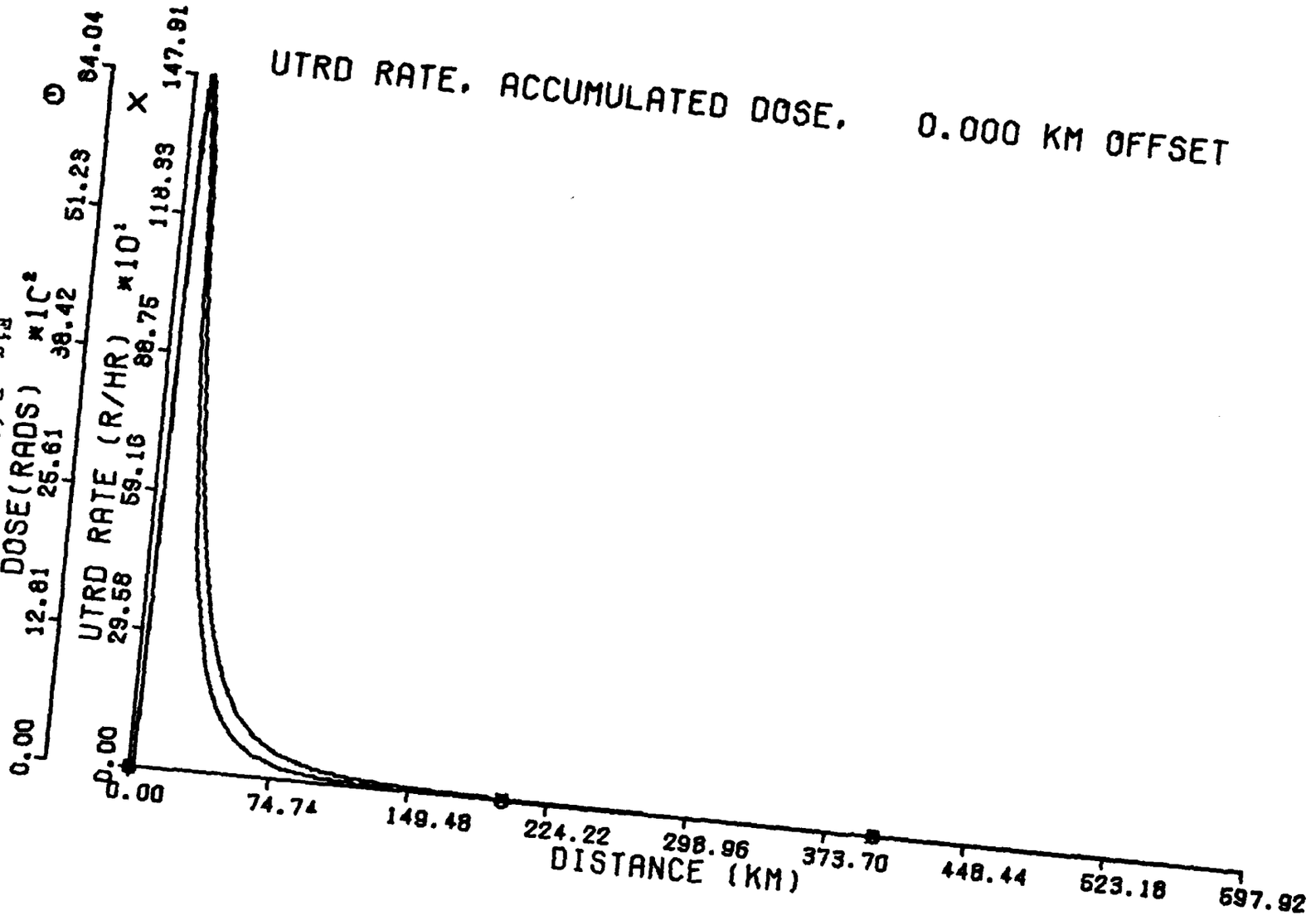

G(T), CUM G(T), .100 MEGATON, 135.21 UM, .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.13
0.27
0.53
0.66
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-68.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
UTRD RATE (R/HR)
*10¹
*1C²
0.00
12.81
25.61
38.42
51.23
64.04
0.00
29.58
59.16
88.75
118.33
147.91
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
Fig. E-69. 165

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .90

MAX G(T), .35349E+00 PER HR, OCCURRED AT .750 HOURS

MAX UTRD RATE, 23518.562 RADS/HR, OCCURRED AT 16.67 KM

MAX ACCUM DOSE, 86898.501 RADS, OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 994.338 RADS OCCURRED AT 158.33 KM

ACCUMULATED DOSE OF 497.744 RADS OCCURRED AT 197.92 KM

ACCUMULATED DOSE OF 99.616 RADS OCCURRED AT 322.92 KM

UTRD RATE OF 2888.838 RADS/HR OCCURRED AT 83.33 KM

UTRD RATE OF 970.567 RADS/HR OCCURRED AT 131.25 KM

UTRD RATE OF 294.253 RADS/HR OCCURRED AT 206.25 KM

UTRD RATE OF 98.505 RADS/HR OCCURRED AT 304.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.59
AT	5.333	HOURS, CUMULATIVE G(T) IS	.78
AT	7.917	HOURS, CUMULATIVE G(T) IS	.85
AT	10.500	HOURS, CUMULATIVE G(T) IS	.89
AT	13.083	HOURS, CUMULATIVE G(T) IS	.92
AT	15.667	HOURS, CUMULATIVE G(T) IS	.93
AT	18.250	HOURS, CUMULATIVE G(T) IS	.94
AT	20.833	HOURS, CUMULATIVE G(T) IS	.95
AT	23.417	HOURS, CUMULATIVE G(T) IS	.96

Fig. E-70.

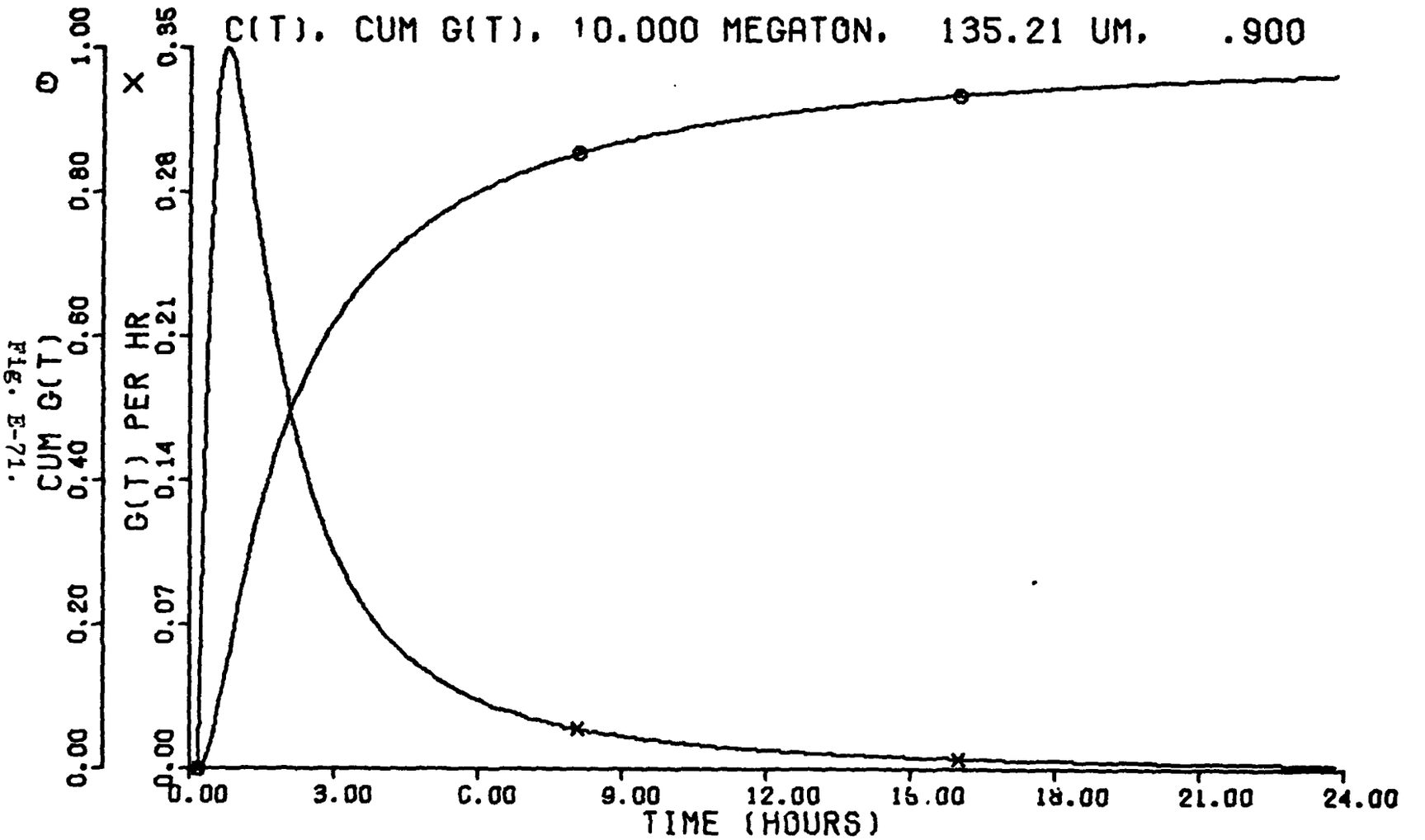

C(T), CUM G(T), 10.000 MEGATON, 135.21 UM, .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.00
0.07
0.14
0.21
0.28
0.35
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-71.

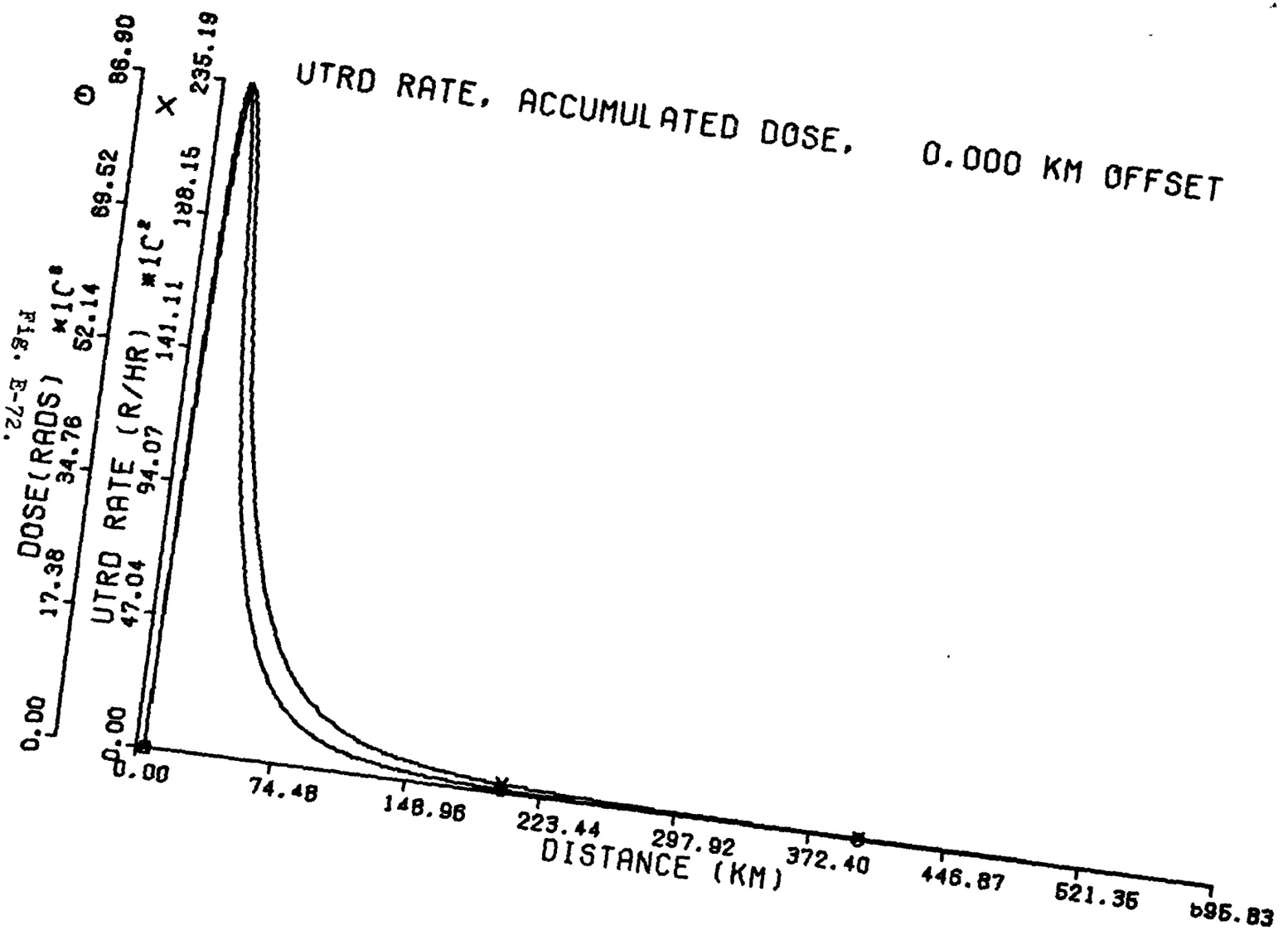

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
0.00
17.38
34.76
52.14
69.52
86.90
UTRD RATE (R/HR)
0.00
47.04
94.07
141.11
188.15
235.19
*10⁻³
*10⁻²
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)

Fig. E-72.

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 135.21 MICRONS, SLOPE .90

MAX G(T), .323466+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 28148.864 RADS/HR, OCCURRED AT 18.75 KM

MAX ACCUM DOSE, 101465.407 RADS, OCCURRED AT 15.67 KM

ACCUMULATED DOSE OF 986.072 RADS OCCURRED AT 189.58 KM

ACCUMULATED DOSE OF 491.326 RADS OCCURRED AT 237.50 KM

ACCUMULATED DOSE OF 99.946 RADS OCCURRED AT 385.42 KM

UTRD RATE OF 2881.315 RADS/HR OCCURRED AT 102.08 KM

UTRD RATE OF 980.939 RADS/HR OCCURRED AT 161.42 KM

UTRD RATE OF 293.456 RADS/HR OCCURRED AT 254.17 KM

UTRD RATE OF 98.459 RADS/HR OCCURRED AT 375.00 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.56
AT	5.333	HOURS, CUMULATIVE G(T) IS	.75
AT	7.917	HOURS, CUMULATIVE G(T) IS	.83
AT	10.500	HOURS, CUMULATIVE G(T) IS	.88
AT	13.083	HOURS, CUMULATIVE G(T) IS	.90
AT	15.667	HOURS, CUMULATIVE G(T) IS	.92
AT	18.250	HOURS, CUMULATIVE G(T) IS	.94
AT	20.833	HOURS, CUMULATIVE G(T) IS	.95
AT	23.417	HOURS, CUMULATIVE G(T) IS	.95

Fig. E-73.

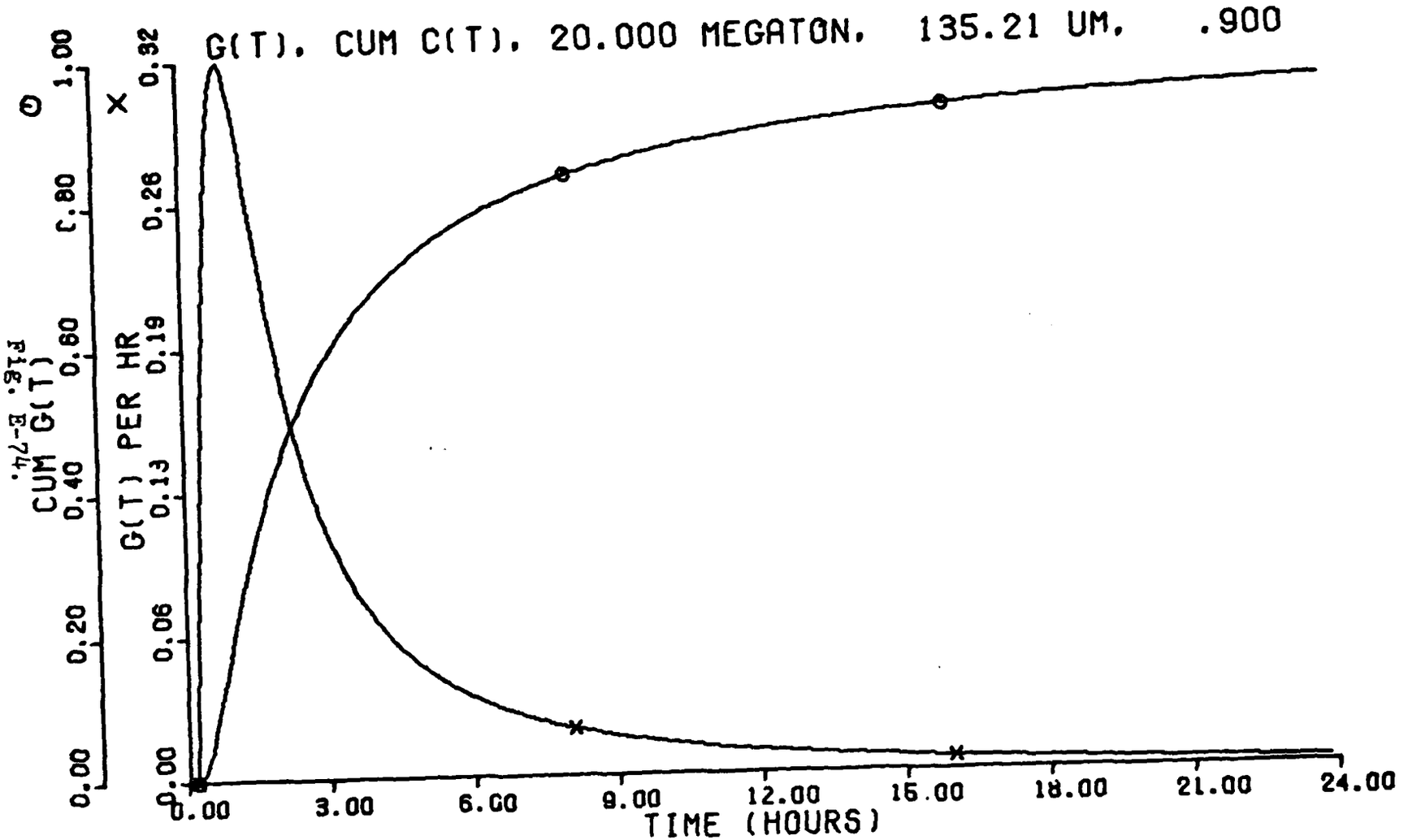

G(T), CUM C(T), 20.000 MEGATON, 135.21 UM, .900
CUM G(T)
G(T) PER HR
TIME (HOURS)
0.00
0.20
0.40
0.60
0.80
1.00
0.13
0.19
0.26
0.32
0.06
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00

Fig. E-74.

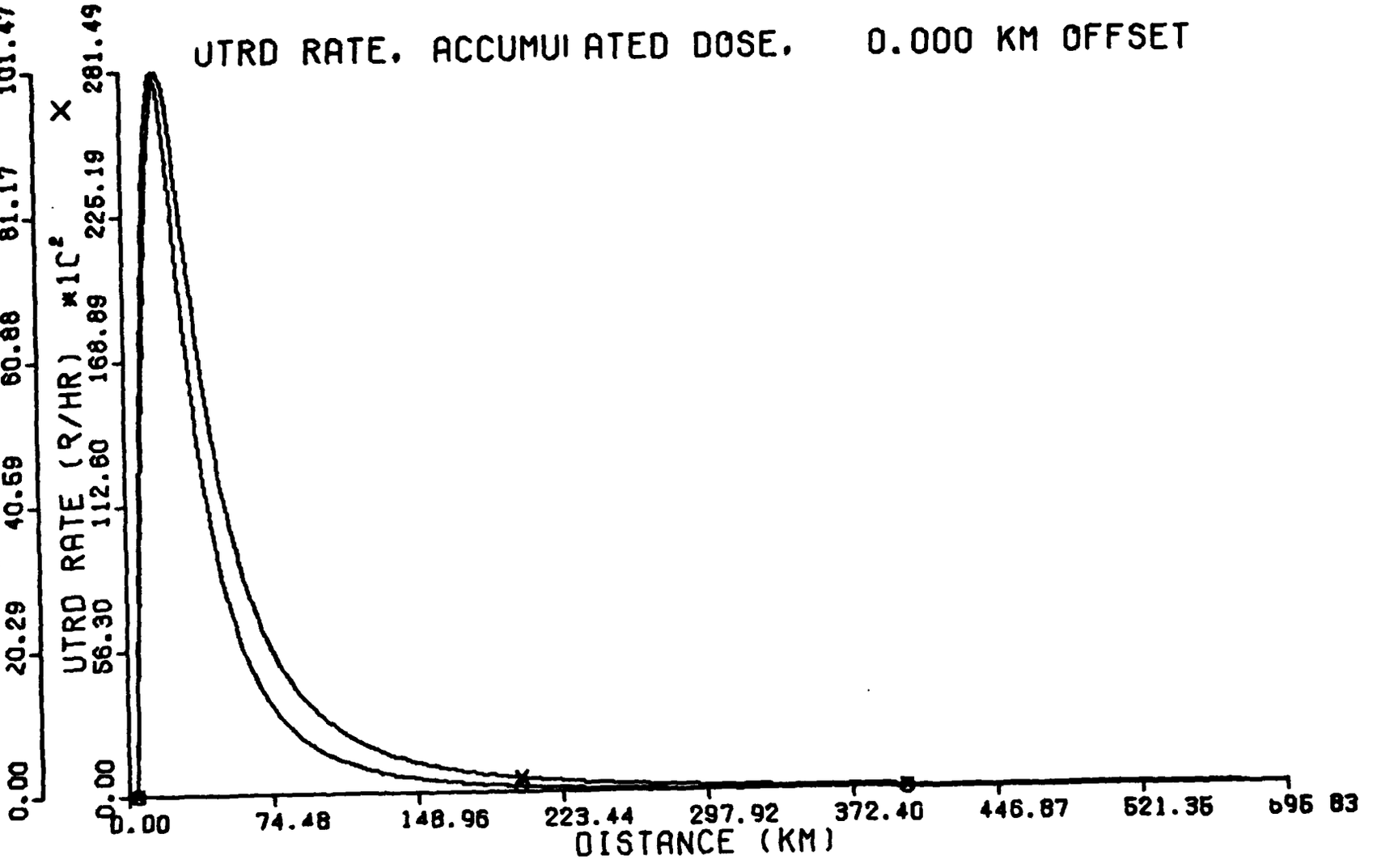

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *1C³
UTRD RATE (R/HR) *1C²
0.00
20.29
40.59
60.88
81.17
101.47
0.00
56.30
112.60
168.89
225.19
281.49
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

Fig. E-75.

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .01 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .84142E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 59.671 RADS/HR, OCCURRED AT 6.25 KM

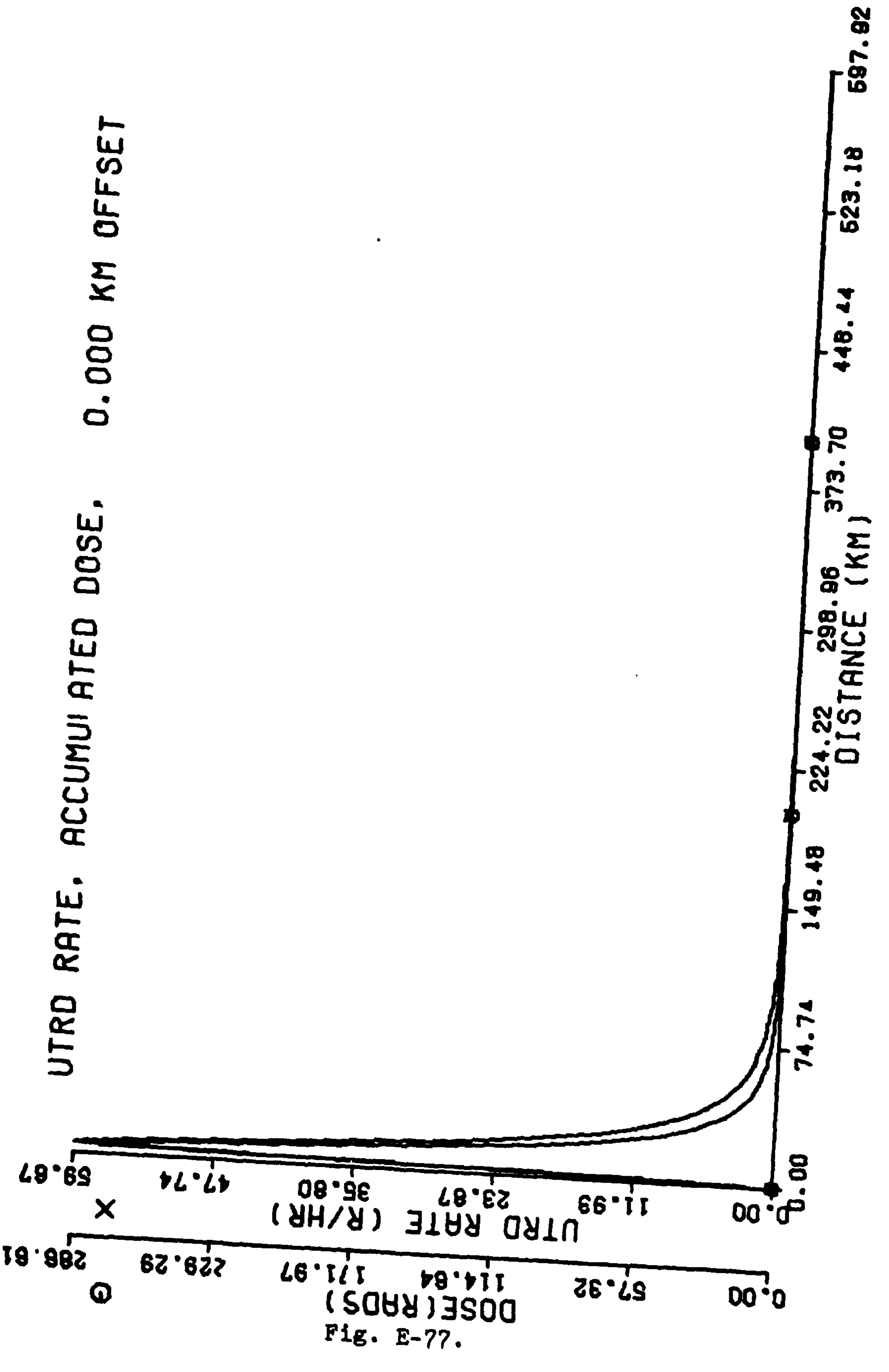
MAX ACCUM DOSE, 266.611 RADS, OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 82.661 RADS OCCURRED AT 18.75 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.84
AT	5.333	HOURS, CUMULATIVE G(T) IS	.95
AT	8.000	HOURS, CUMULATIVE G(T) IS	.98
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-76.



UTRD RATE, ACCUMUI ATED DOSE, 0.000 KM OFFSET
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
0.00
11.93
23.87
35.80
47.74
59.67
X
UTRD RATE (R/HR)
0.00
57.32
114.64
171.97
229.29
286.61
DOSE(RADS)

Fig. E-77.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .29695E+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 115.519 RADS/HR, OCCURRED AT 16.67 KM

MAX ACCUM DOSE, 425.667 RADS, OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 98.837 RADS OCCURRED AT 56.25 KM

UTRD RATE OF 95.717 RADS/HR OCCURRED AT 27.08 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.53
AT	5.333	HOURS, CUMULATIVE G(T) IS	.76
AT	8.000	HOURS, CUMULATIVE G(T) IS	.85
AT	10.667	HOURS, CUMULATIVE G(T) IS	.90
AT	13.333	HOURS, CUMULATIVE G(T) IS	.93
AT	16.000	HOURS, CUMULATIVE G(T) IS	.95
AT	18.667	HOURS, CUMULATIVE G(T) IS	.96
AT	21.333	HOURS, CUMULATIVE G(T) IS	.97

Fig. E-78.

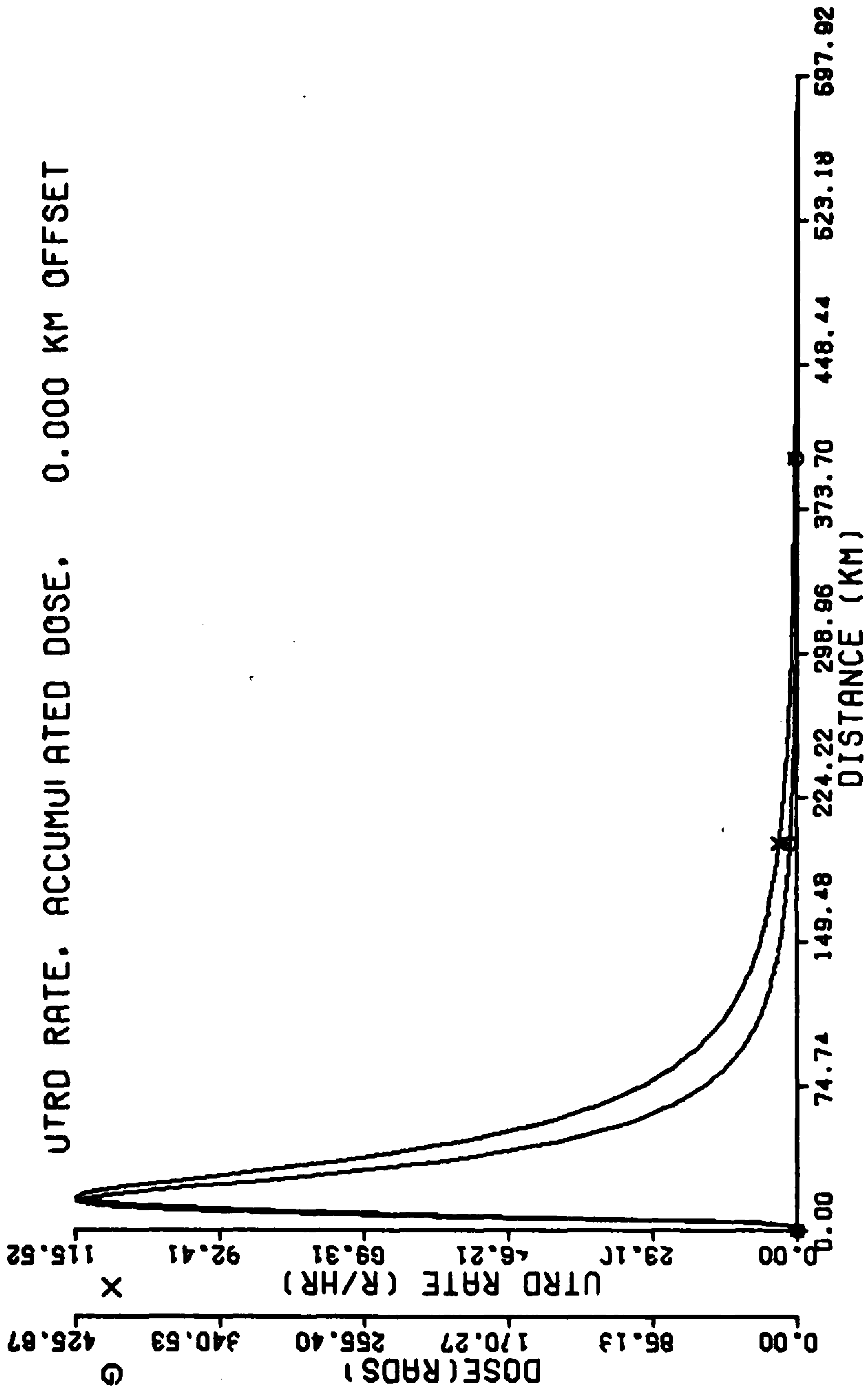

UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
UTRD RATE (R/HR)
0.00
23.10
46.21
69.31
92.41
115.52
DOSE(RADS)
0.00
85.13
170.27
255.40
340.53
425.67

Fig. E-79.

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .14371E+00 PER HR, OCCURRED AT 1.667 HOURS

MAX UTRD RATE, 223.901 RADS/HR, OCCURRED AT 33.33 KM

MAX ACCUM DOSE, 670.721 RADS, OCCURRED AT 29.17 KM

ACCUMULATED DOSE OF 494.206 RADS OCCURRED AT 50.00 KM

ACCUMULATED DOSE OF 97.149 RADS OCCURRED AT 133.33 KM

UTRD RATE OF 99.881 RADS/HR OCCURRED AT 91.67 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.333	HOURS, CUMULATIVE G(T) IS	.52
AT	8.000	HOURS, CUMULATIVE G(T) IS	.66
AT	10.667	HOURS, CUMULATIVE G(T) IS	.75
AT	13.333	HOURS, CUMULATIVE G(T) IS	.80
AT	16.000	HOURS, CUMULATIVE G(T) IS	.84
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.90

Fig. E-80.

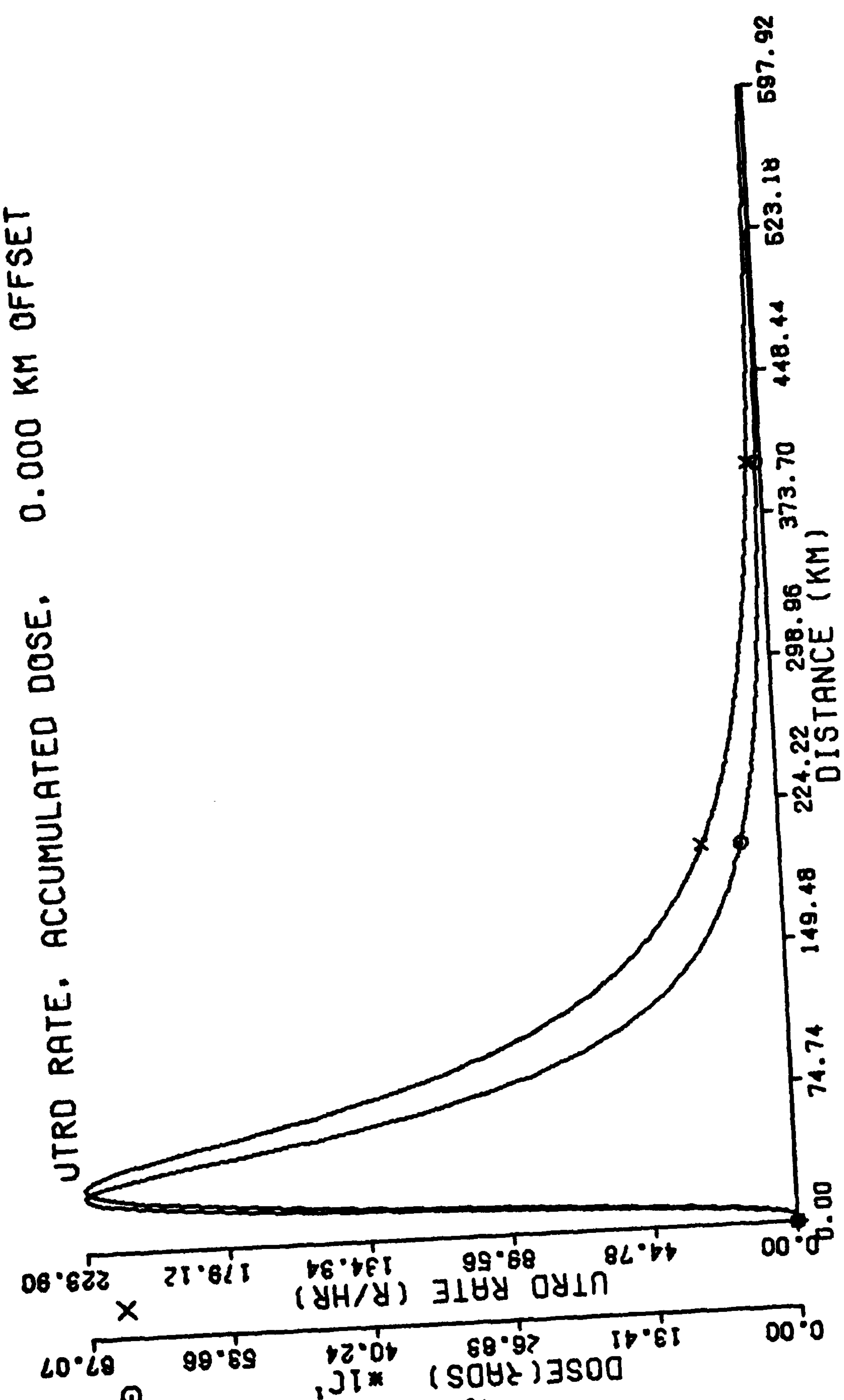

UTRD RATE, ACCUMULATED DOSE. 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
UTRD RATE (R/HR)
0.00
44.78
89.56
134.94
179.12
223.90
DOSE (RADS) *10¹
0.00
13.41
26.83
40.24
53.66
67.07

Fig. E-81.

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .70210E-01 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 3211.488 RADS/HR, OCCURRED AT 60.42 KM

MAX ACCUM DOSE, 7960.222 RADS, OCCURRED AT 50.00 KM

ACCUMULATED DOSE OF 993.354 RADS OCCURRED AT 252.08 KM

ACCUMULATED DOSE OF 498.428 RADS OCCURRED AT 335.42 KM

ACCUMULATED DOSE OF 99.060 RADS OCCURRED AT 593.75 KM

UTRD RATE OF 2990.949 RADS/HR OCCURRED AT 79.17 KM

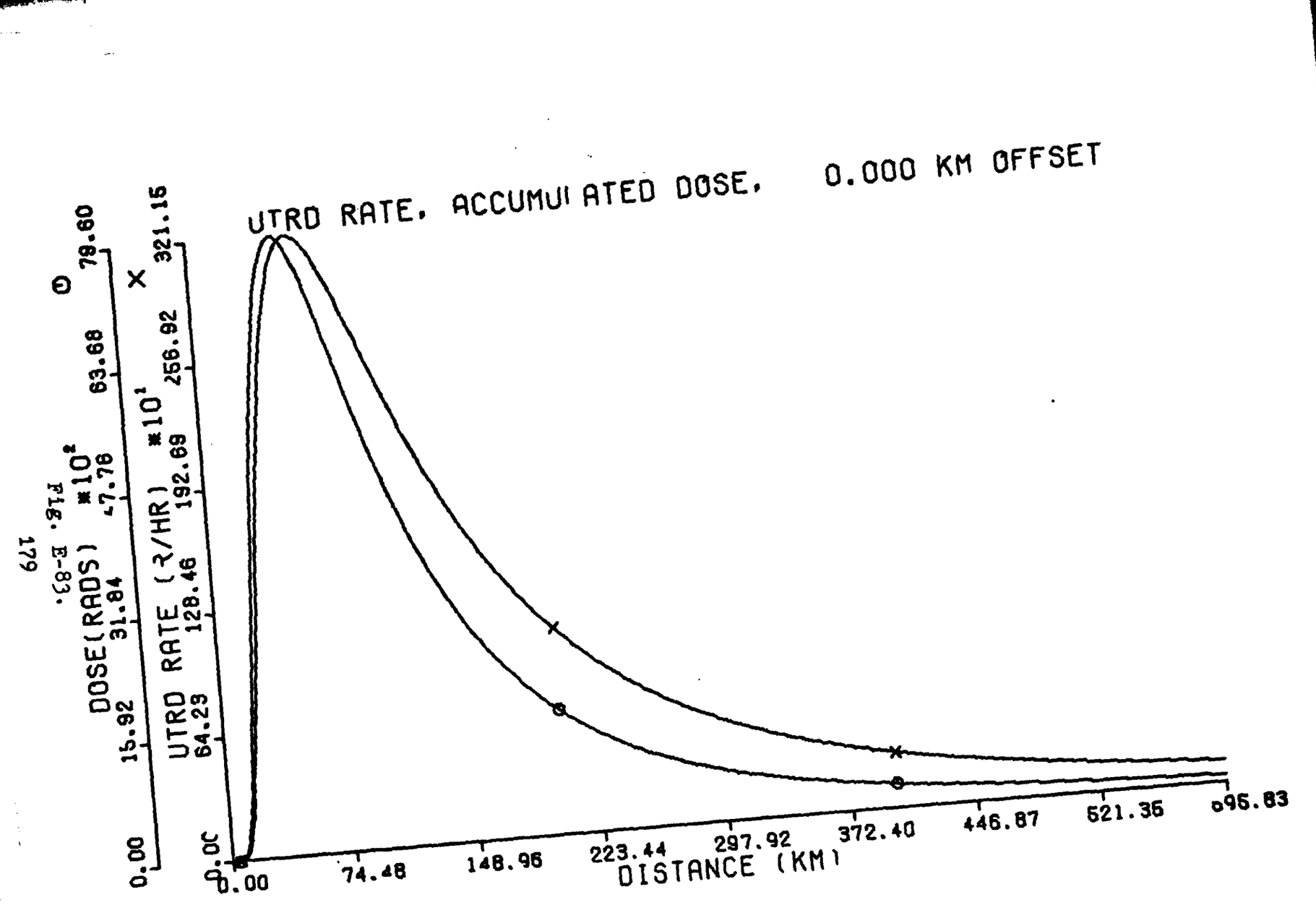
UTRD RATE OF 985.518 RADS/HR OCCURRED AT 212.50 KM

UTRD RATE OF 297.432 RADS/HR OCCURRED AT 395.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.10
AT	5.333	HOURS, CUMULATIVE G(T) IS	.27
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.50
AT	13.083	HOURS, CUMULATIVE G(T) IS	.58
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.69
AT	20.833	HOURS, CUMULATIVE G(T) IS	.72
AT	23.417	HOURS, CUMULATIVE G(T) IS	.76

Fig. E-82.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10¹
0.00
15.92
31.84
47.76
63.68
78.60
0.00
64.23
128.46
192.69
256.92
321.15
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
DISTANCE (KM)
FIG. E-83.
179

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR .60 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .62476E-01 PER HR, OCCURRED AT 3.500 HOURS

MAX UTRD RATE, 3764.767 RADS/HR, OCCURRED AT 56.67 KM

MAX ACCUM DOSE, 9030.008 RADS, OCCURRED AT 56.25 KM

ACCUMULATED DOSE OF 992.347 RADS OCCURRED AT 302.08 KM

ACCUMULATED DOSE OF 493.885 RADS OCCURRED AT 402.08 KM

UTRD RATE OF 2998.937 RADS/HR OCCURRED AT 112.50 KM

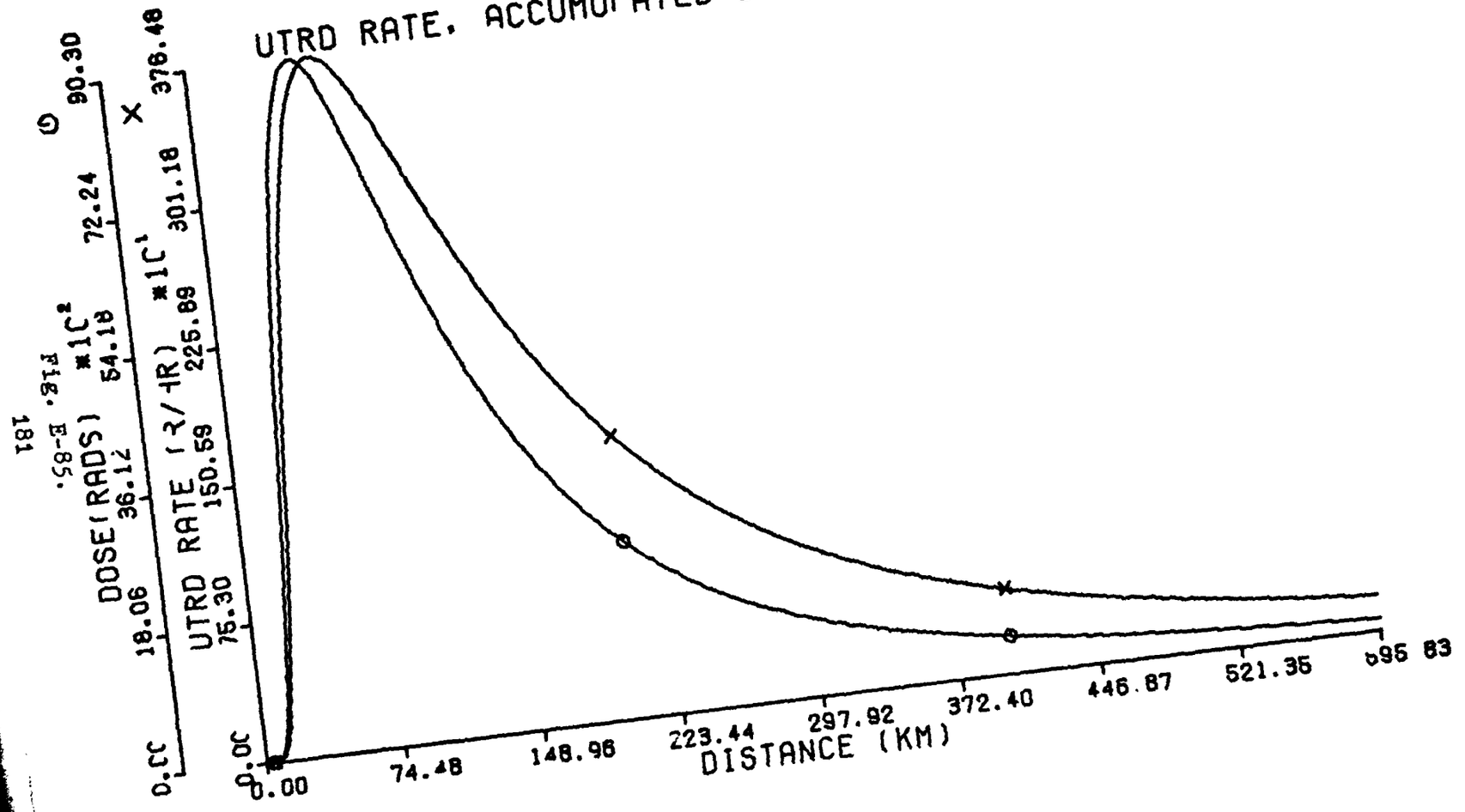
UTRD RATE OF 993.534 RADS/HR OCCURRED AT 266.67 KM

UTRD RATE OF 299.631 RADS/HR OCCURRED AT 491.67 KM

SELECTED CUMULATIVE G(T) DATA

AT .167 HOURS, CUMULATIVE G(T) IS 0.00
AT 2.750 HOURS, CUMULATIVE G(T) IS .08
AT 5.333 HOURS, CUMULATIVE G(T) IS .24
AT 7.917 HOURS, CUMULATIVE G(T) IS .36
AT 10.500 HOURS, CUMULATIVE G(T) IS .46
AT 13.083 HOURS, CUMULATIVE G(T) IS .54
AT 15.667 HOURS, CUMULATIVE G(T) IS .60
AT 18.250 HOURS, CUMULATIVE G(T) IS .65
AT 20.833 HOURS, CUMULATIVE G(T) IS .69
AT 23.417 HOURS, CUMULATIVE G(T) IS .72

Fig. E-84.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
FILE: E-85, 181
DOSE(RADS) *1C² 54.18 72.24 90.30
36.12
18.06
0.00
UTRD RATE (R/HR) *1C¹ 225.89 301.18 376.48
150.59
75.30
0.00
0.00 74.48 148.96 223.44 297.92 372.40 446.87 521.35 595.83
DISTANCE (KM)

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .41 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .63

MAX G(T), .84142E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 59.026 RADS/HR, OCCURRED AT 6.25 KM

MAX ACCUM DOSE, 283.511 RADS, OCCURRED AT 6.25 KM

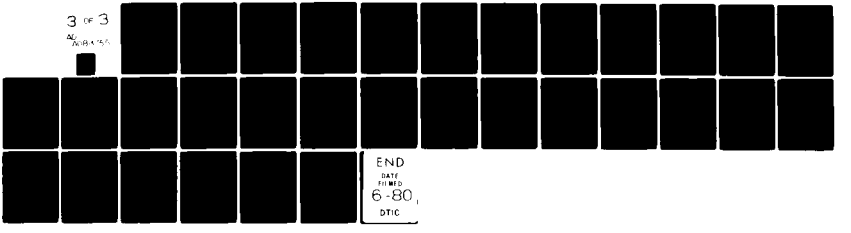
ACCUMULATED DOSE OF 97.485 RADS OCCURRED AT 16.67 KM

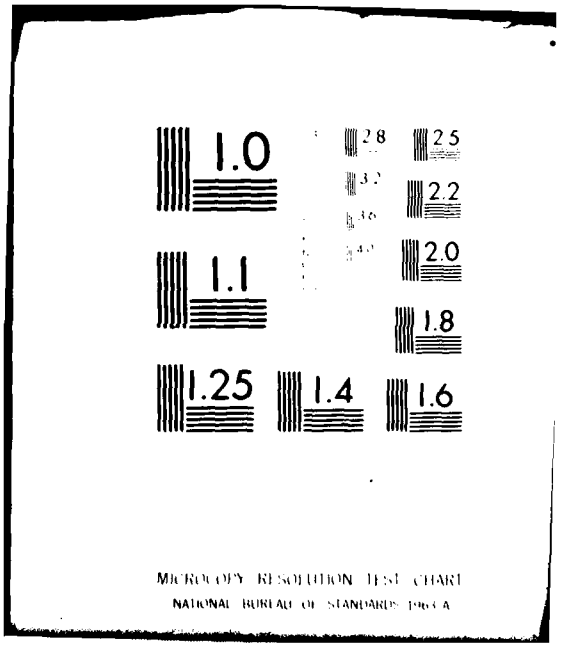
SELECTED CUMULATIVE G(T) DATA

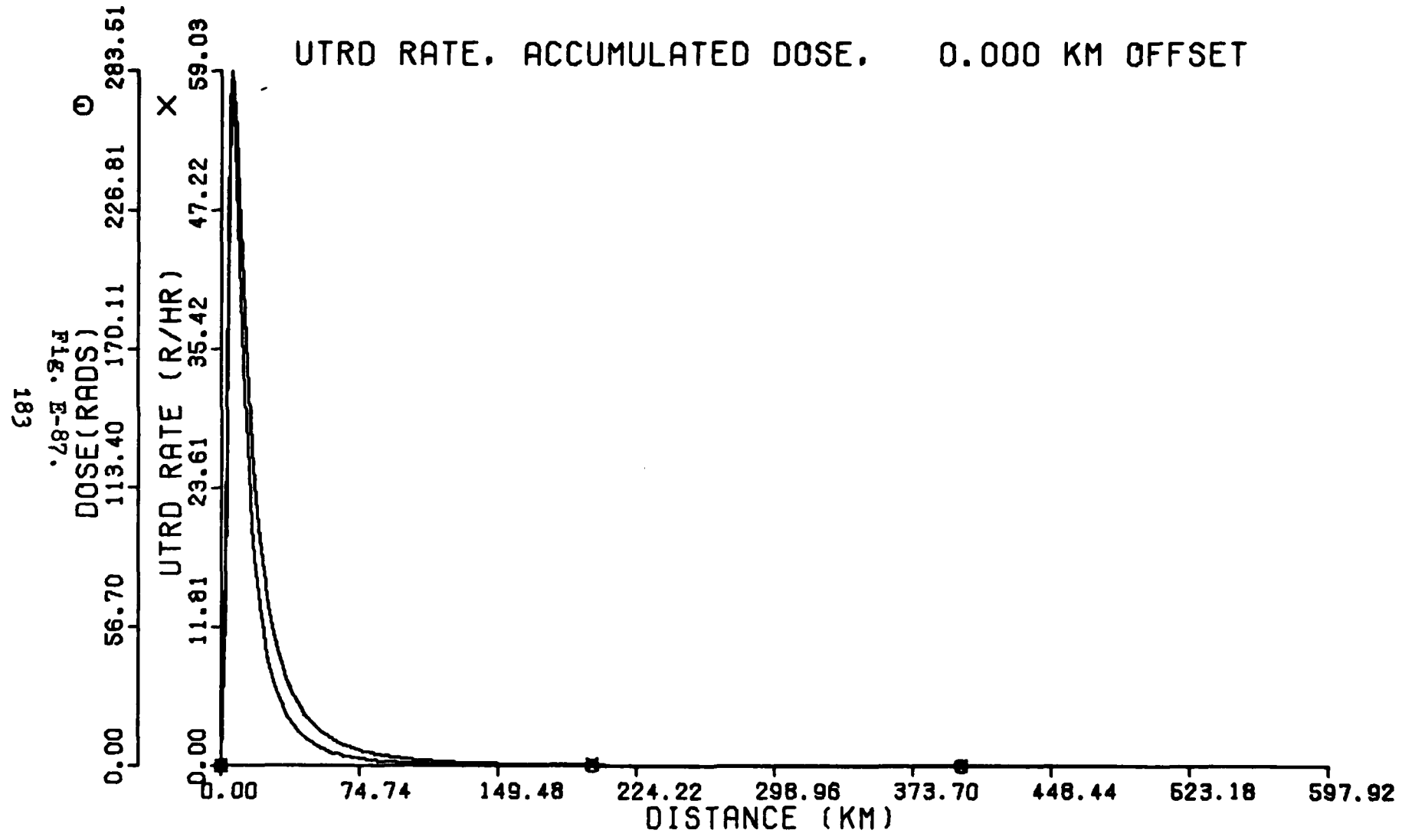
AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.84
AT	5.333	HOURS, CUMULATIVE G(T) IS	.95
AT	8.000	HOURS, CUMULATIVE G(T) IS	.98
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-86.

AD-A083 755 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOO--ETC F/6 18/8
A COMPUTER FALLOUT MODEL FOR OPERATIONAL TYPE STUDIES.(U)
MAR 80 R F COLARCO
UNCLASSIFIED AFIT/GST/PH/80M-1 NL




1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A


UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DOSE(RADS)
0.00
56.70
113.40
170.11
226.81
283.51
UTRD RATE (R/HR)
0.00
11.81
23.61
35.42
47.22
59.03
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
FIG. E-87.
183

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .29695E+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 96.322 RADS/HR, OCCURRED AT 14.58 KM

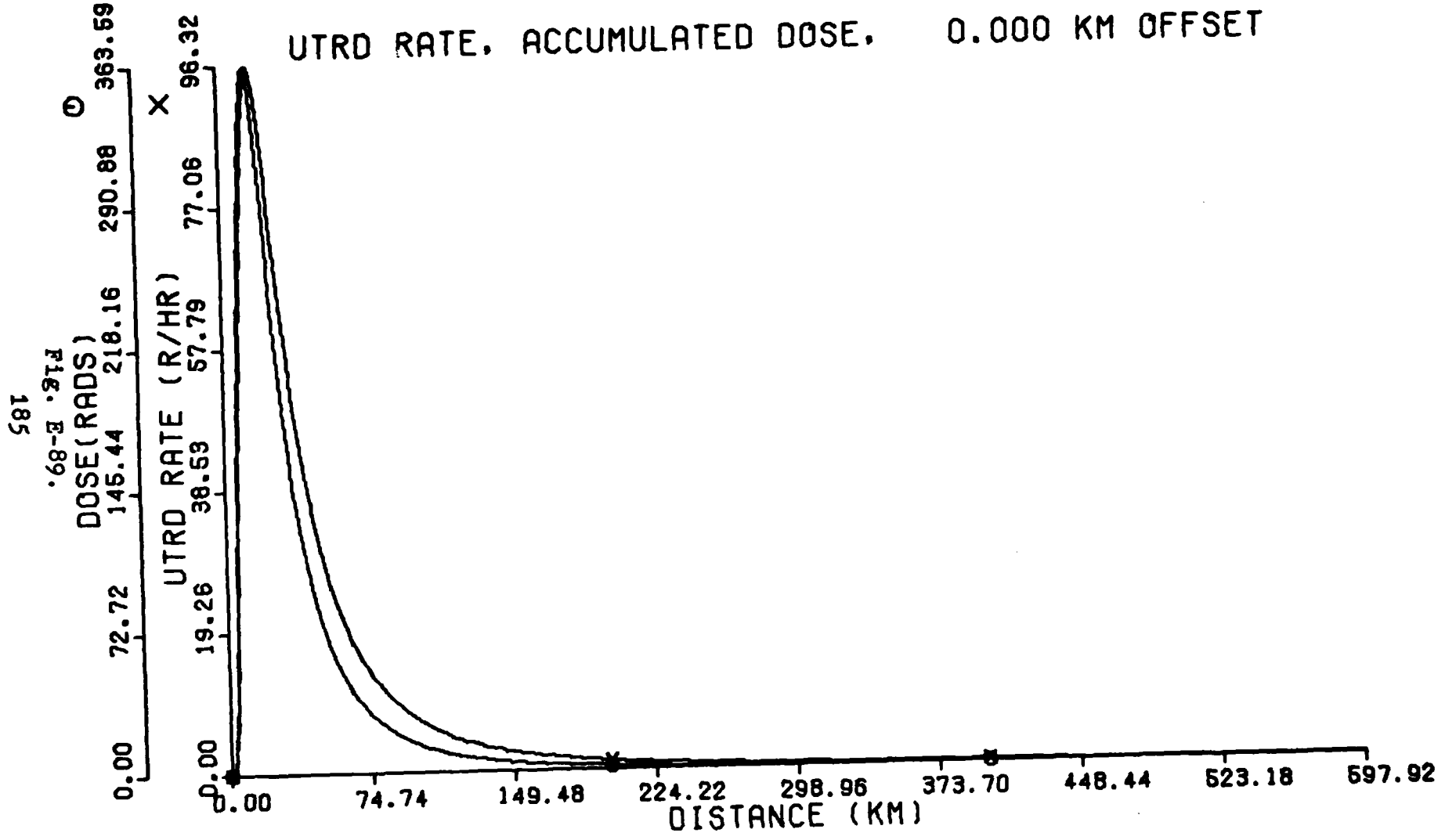
MAX ACCUM DOSE, 363.594 RADS, OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 91.461 RADS OCCURRED AT 45.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.53
AT	5.333	HOURS, CUMULATIVE G(T) IS	.76
AT	8.000	HOURS, CUMULATIVE G(T) IS	.85
AT	10.667	HOURS, CUMULATIVE G(T) IS	.90
AT	13.333	HOURS, CUMULATIVE G(T) IS	.93
AT	16.000	HOURS, CUMULATIVE G(T) IS	.95
AT	18.667	HOURS, CUMULATIVE G(T) IS	.96
AT	21.333	HOURS, CUMULATIVE G(T) IS	.97

Fig. E-88.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS)
0.00
72.72
145.44
218.16
290.88
363.59
UTRD RATE (R/HR)
0.00
19.26
38.53
57.79
77.06
96.32
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)
FIG. E-89.
185

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .14371E+00 PER HR, OCCURRED AT 1.667 HOURS

MAX UTRD RATE, 147.886 RADS/HR, OCCURRED AT 29.17 KM

MAX ACCUM DOSE, 464.705 RADS, OCCURRED AT 25.00 KM

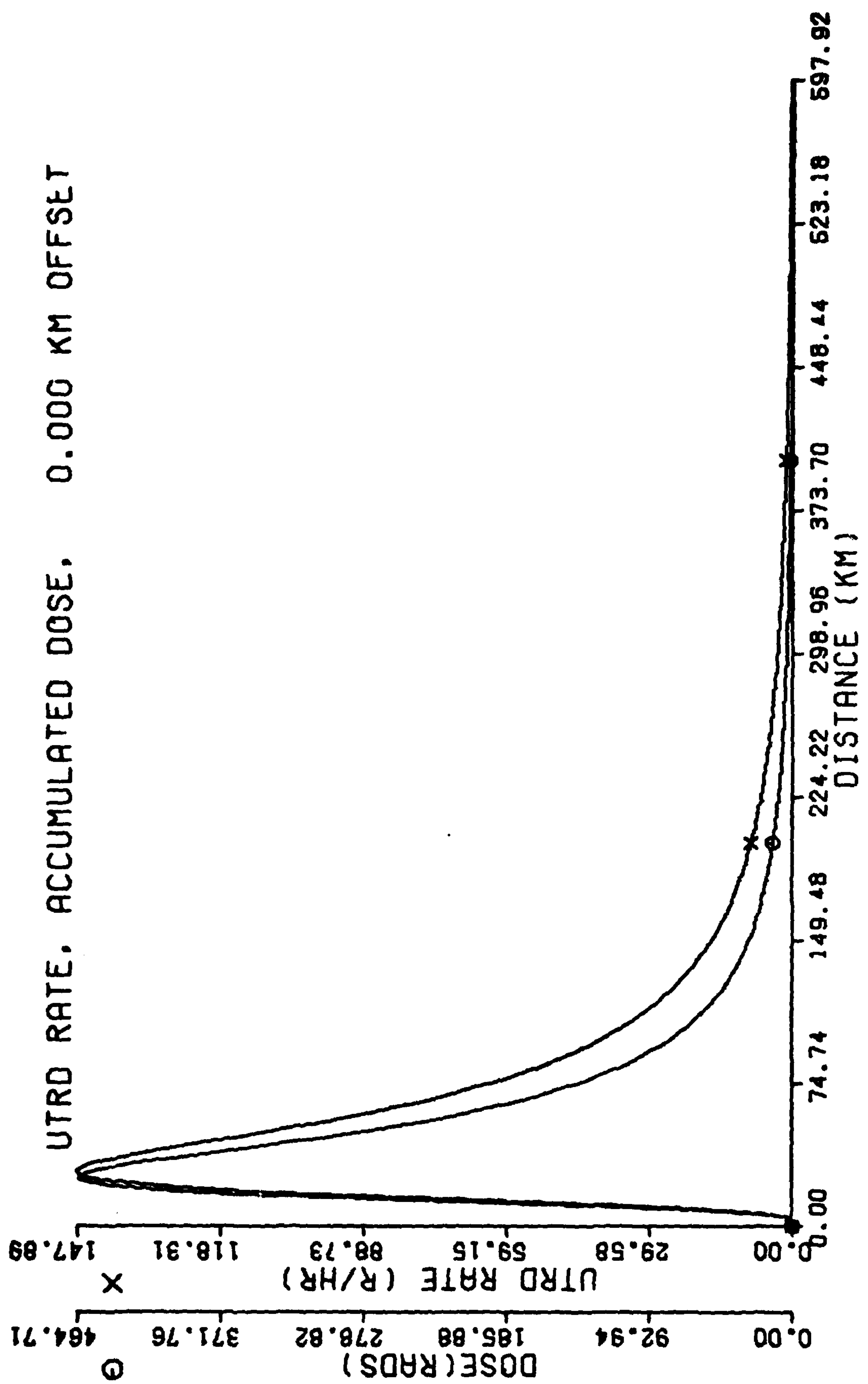
ACCUMULATED DOSE OF 96.205 RADS OCCURRED AT 89.58 KM

UTRD RATE OF 97.686 RADS/HR OCCURRED AT 54.17 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.333	HOURS, CUMULATIVE G(T) IS	.52
AT	8.000	HOURS, CUMULATIVE G(T) IS	.66
AT	10.667	HOURS, CUMULATIVE G(T) IS	.75
AT	13.333	HOURS, CUMULATIVE G(T) IS	.80
AT	16.000	HOURS, CUMULATIVE G(T) IS	.84
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.90

Fig. E-90.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
UTRD RATE (R/HR)
0.00
29.58
59.15
88.73
118.31
147.89
DOSE(RADS)
0.00
92.94
185.88
278.82
371.76
464.71

Fig, E-91.

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .70210E-01 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 1821.724 RADS/HR, OCCURRED AT 50.00 KM

MAX ACCUM DOSE, 4802.248 RADS, OCCURRED AT 43.75 KM

ACCUMULATED DOSE OF 973.910 RADS OCCURRED AT 158.33 KM

ACCUMULATED DOSE OF 493.914 RADS OCCURRED AT 214.58 KM

ACCUMULATED DOSE OF 98.604 RADS OCCURRED AT 395.83 KM

UTRD RATE OF 982.001 RADS/HR OCCUPRED AT 112.50 KM

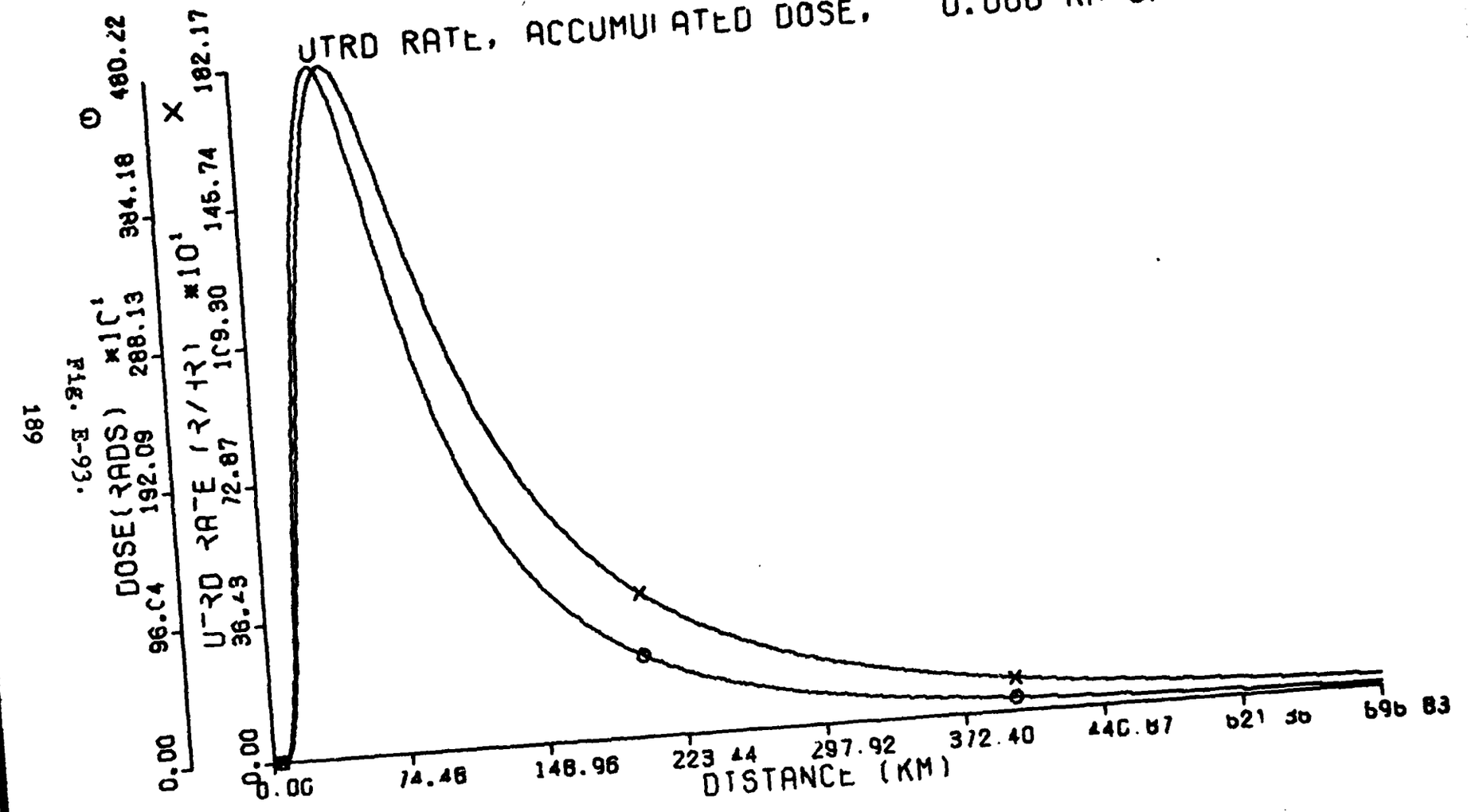
UTRD RATE OF 297.926 RADS/HR OCCURRED AT 229.17 KM

UTRD RATE OF 99.382 RADS/HR OCCURRED AT 381.25 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.10
AT	5.333	HOURS, CUMULATIVE G(T) IS	.27
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.50
AT	13.083	HOURS, CUMULATIVE G(T) IS	.58
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.69
AT	20.833	HOURS, CUMULATIVE G(T) IS	.72
AT	23.417	HOURS, CUMULATIVE G(T) IS	.76

Fig. E-92.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
U-RD RATE (R/HR) *10¹
0.00
96.04
192.09
288.13
384.18
480.22
0.00
36.43
72.87
109.30
145.74
182.17
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
596.83
DISTANCE (KM)

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 29612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 2.40 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .62476E-01 PER HR, OCCURRED AT 3.500 HOURS

MAX UTRD RATE, 2387.216 RADS/HR, OCCURRED AT 54.17 KM

MAX ACCUM DOSE, 6078.030 RADS, OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 999.849 RADS OCCURRED AT 195.83 KM

ACCUMULATED DOSE OF 498.177 RADS OCCURRED AT 254.58 KM

ACCUMULATED DOSE OF 99.853 RADS OCCURRED AT 479.17 KM

UTRD RATE OF 993.686 RADS/HR OCCURRED AT 152.08 KM

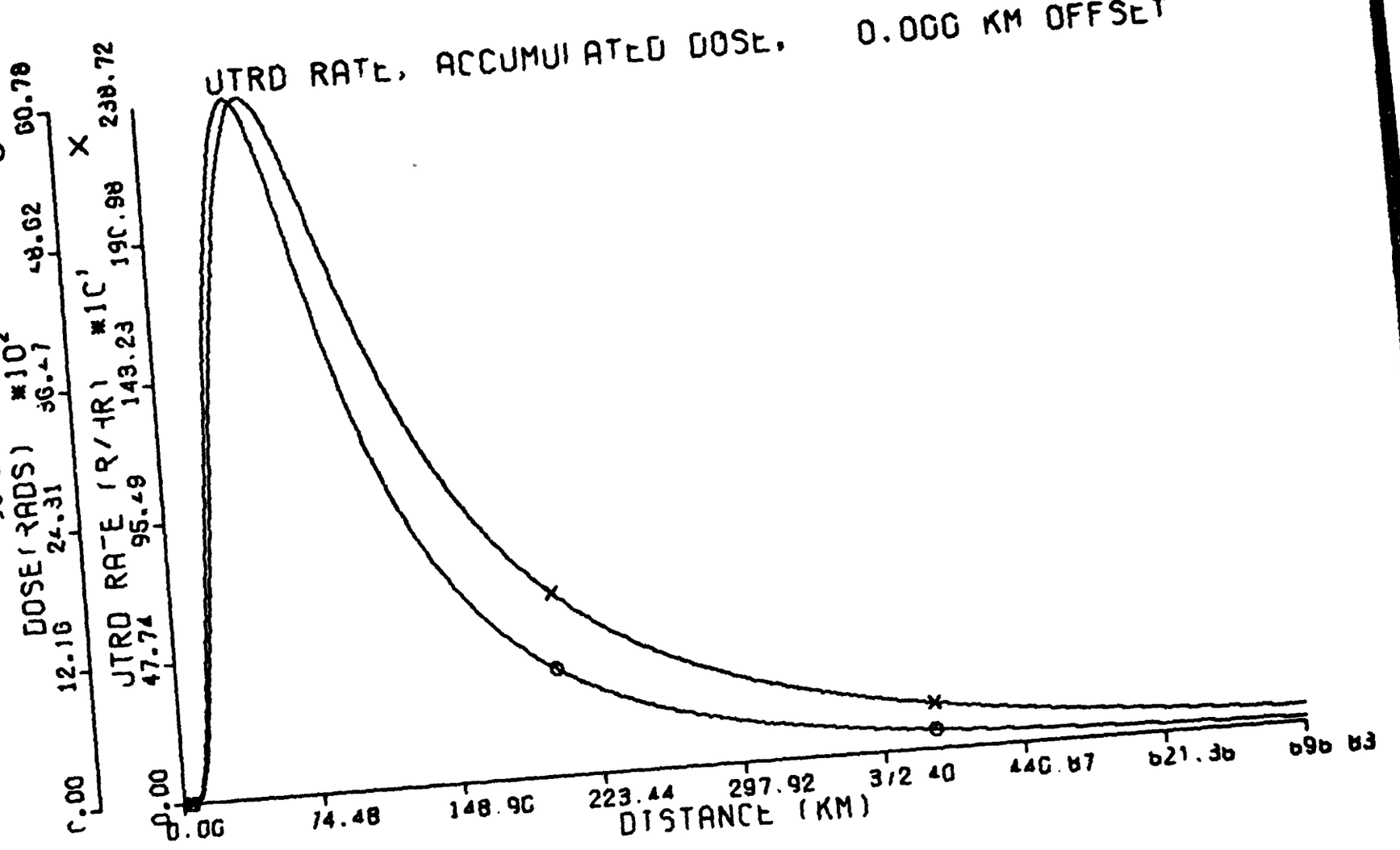
UTRD RATE OF 295.748 RADS/HR OCCURRED AT 297.92 KM

UTRD RATE OF 99.228 RADS/HR OCCURRED AT 485.42 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.08
AT	5.333	HOURS, CUMULATIVE G(T) IS	.24
AT	7.917	HOURS, CUMULATIVE G(T) IS	.36
AT	10.500	HOURS, CUMULATIVE G(T) IS	.46
AT	13.083	HOURS, CUMULATIVE G(T) IS	.54
AT	15.667	HOURS, CUMULATIVE G(T) IS	.60
AT	18.250	HOURS, CUMULATIVE G(T) IS	.65
AT	20.833	HOURS, CUMULATIVE G(T) IS	.69
AT	23.417	HOURS, CUMULATIVE G(T) IS	.72

Fig. E-94.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10²
UTRD RATE (R/HR) *10¹
0.00
12.10
24.31
36.47
48.62
60.78
0.00
47.74
95.49
143.23
190.98
238.72
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.36
596.83
DISTANCE (KM)

YIELD .001 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .11 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .84142E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 29.768 RADS/HR, OCCURRED AT 12.50 KM

MAX ACCUM DOSE, 142.981 RADS, OCCURRED AT 12.50 KM

ACCUMULATED DOSE OF 97.114 RADS OCCURRED AT 20.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.84
AT	5.333	HOURS, CUMULATIVE G(T) IS	.95
AT	8.000	HOURS, CUMULATIVE G(T) IS	.98
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-96.

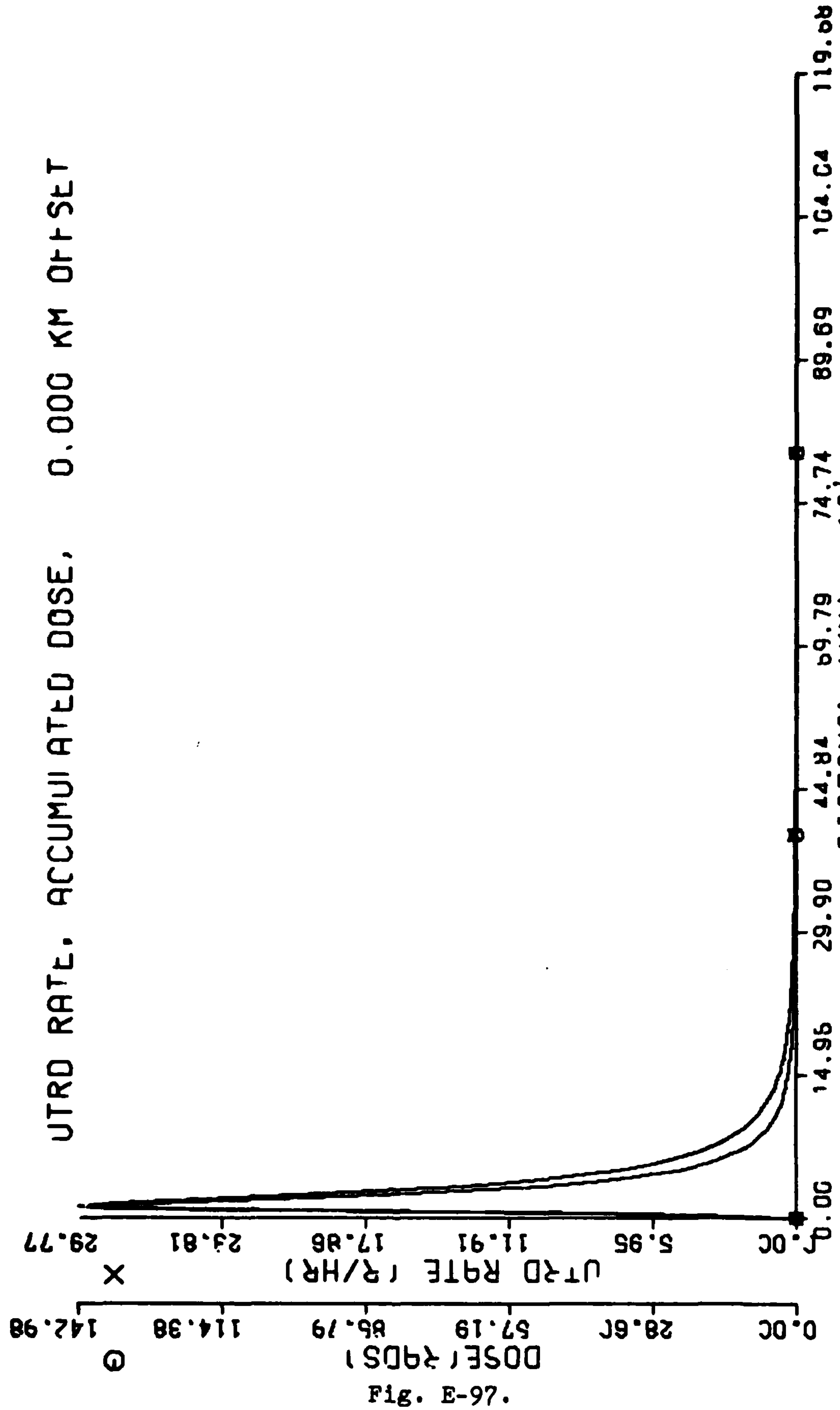

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DISTANCE (KM) *10^1
0.00
14.95
29.90
44.84
59.79
74.74
89.69
104.64
119.58
UTRD RATE (R/HR)
0.00
5.95
11.91
17.86
23.81
29.77
DOSE(RADS)
0.00
28.60
57.19
85.79
114.38
142.98

Fig. E-97.

YIELD .010 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .63

MAX G(T), .29695E+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 55.364 RADS/HR, OCCURRED AT 33.33 KM

MAX ACCUM DOSE, 205.354 RADS, OCCURRED AT 23.17 KM

ACCUMULATED DOSE OF 96.830 RADS OCCURRED AT 70.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.53
AT	5.333	HOURS, CUMULATIVE G(T) IS	.76
AT	8.000	HOURS, CUMULATIVE G(T) IS	.85
AT	10.667	HOURS, CUMULATIVE G(T) IS	.90
AT	13.333	HOURS, CUMULATIVE G(T) IS	.93
AT	16.000	HOURS, CUMULATIVE G(T) IS	.95
AT	18.667	HOURS, CUMULATIVE G(T) IS	.96
AT	21.333	HOURS, CUMULATIVE G(T) IS	.97

Fig. E-98.

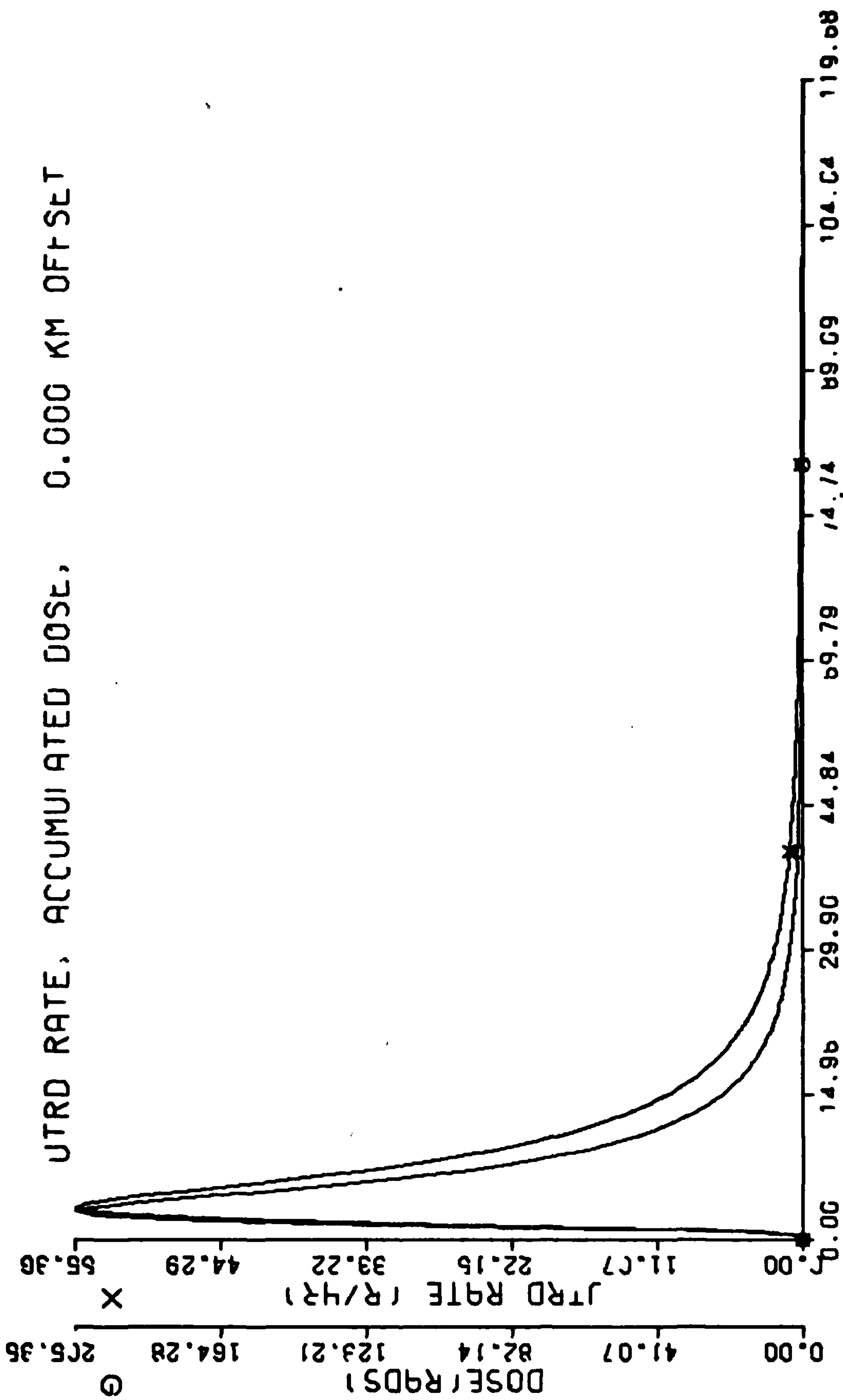

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DISTANCE (KM)
UTRD RATE (R/HR)
DOSE (RADS)

Fig. E-99.

YIELD .100 MEGATONS

FISSION FRACTION .50

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .14371E+00 PER HR, OCCURRED AT 1.667 HOURS

MAX UTRD RATE, 99.159 RADS/HR, OCCURRED AT 52.50 KM

MAX ACCUM DOSE, 302.431 RADS, OCCURRED AT 54.17 KM

ACCUMULATED DOSE OF 96.575 RADS OCCURRED AT 162.50 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.333	HOURS, CUMULATIVE G(T) IS	.52
AT	8.000	HOURS, CUMULATIVE G(T) IS	.66
AT	10.667	HOURS, CUMULATIVE G(T) IS	.75
AT	13.333	HOURS, CUMULATIVE G(T) IS	.80
AT	16.000	HOURS, CUMULATIVE G(T) IS	.84
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.90

Fig. E-100

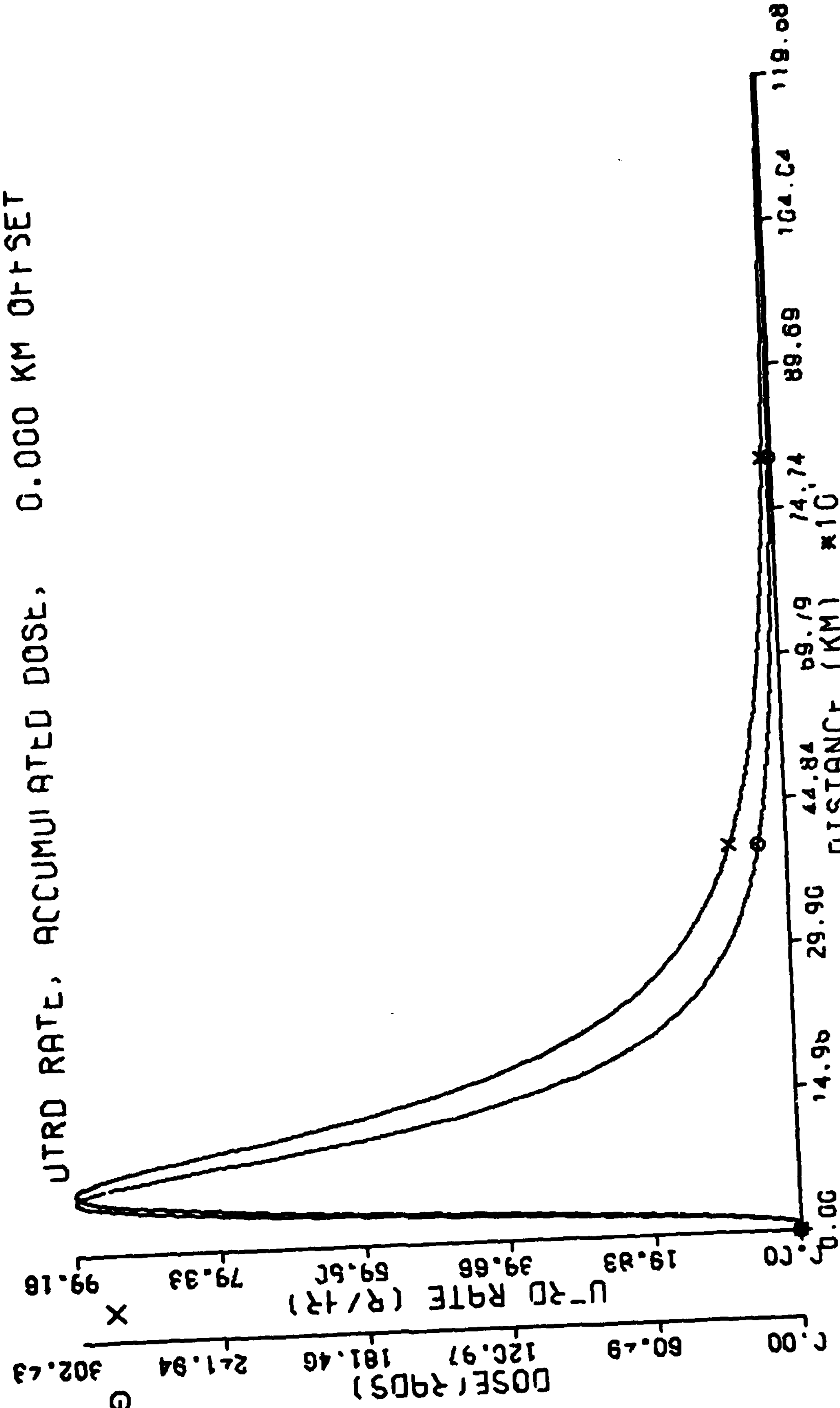

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DISTANCE (KM) ×10
0.00
14.96
29.90
44.84
74.74
89.69
99.18
79.33
39.66
19.83
DOSE (RADS)
302.43
181.46
60.49

Fig. E-101.

YIELD 10.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .70210E-01 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 1333.713 RADS/HR, OCCURRED AT 108.33 KM

MAX ACCUM DOSE, 3397.573 RADS, OCCURRED AT 95.83 KM

ACCUMULATED DOSE OF 988.549 RADS OCCURRED AT 295.83 KM

ACCUMULATED DOSE OF 495.208 RADS OCCURRED AT 412.50 KM

ACCUMULATED DOSE OF 99.866 RADS OCCURRED AT 775.00 KM

UTRD RATE OF 993.663 RADS/HR OCCURRED AT 191.67 KM

UTRD RATE OF 299.579 RADS/HR OCCURRED AT 437.50 KM

UTRD RATE OF 99.475 RADS/HR OCCURRED AT 745.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.10
AT	5.333	HOURS, CUMULATIVE G(T) IS	.27
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.50
AT	13.083	HOURS, CUMULATIVE G(T) IS	.58
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.69
AT	20.833	HOURS, CUMULATIVE G(T) IS	.72
AT	23.417	HOURS, CUMULATIVE G(T) IS	.76

Fig. E-102.

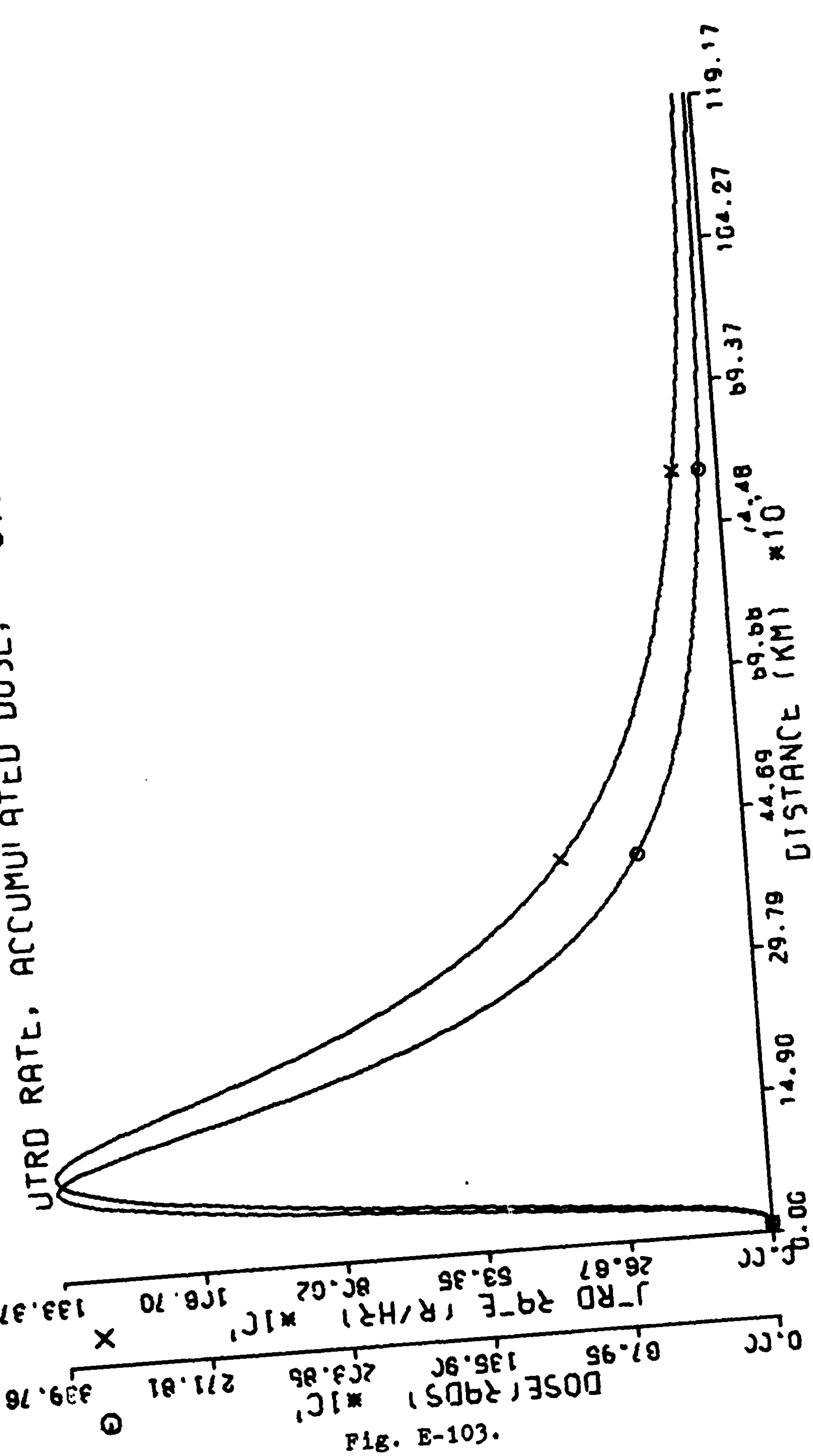

0.000 KM OFFSET
DISTANCE (KM) *10
0.00
14.90
29.79
44.69
74.48
89.37
104.27
119.17
133.37
53.35
26.67
339.76
135.90
67.95

Fig. E-103.

YIELD 20.000 MEGATONS

FISSION FRACTION .50

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.33 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 50.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .62476E-01 PER HR, OCCURRED AT 3.500 HOURS

MAX UTRD RATE, 1638.348 RADS/HR, OCCURRED AT 120.83 KM

MAX ACCUM DOSE, 4026.363 RADS, OCCURRED AT 104.17 KM

ACCUMULATED DOSE OF 987.494 RADS OCCURRED AT 366.67 KM

ACCUMULATED DOSE OF 499.344 RADS OCCURRED AT 504.17 KM

ACCUMULATED DOSE OF 99.935 RADS OCCURRED AT 937.50 KM

UTRD RATE OF 999.649 RADS/HR OCCUPRED AT 262.50 KM

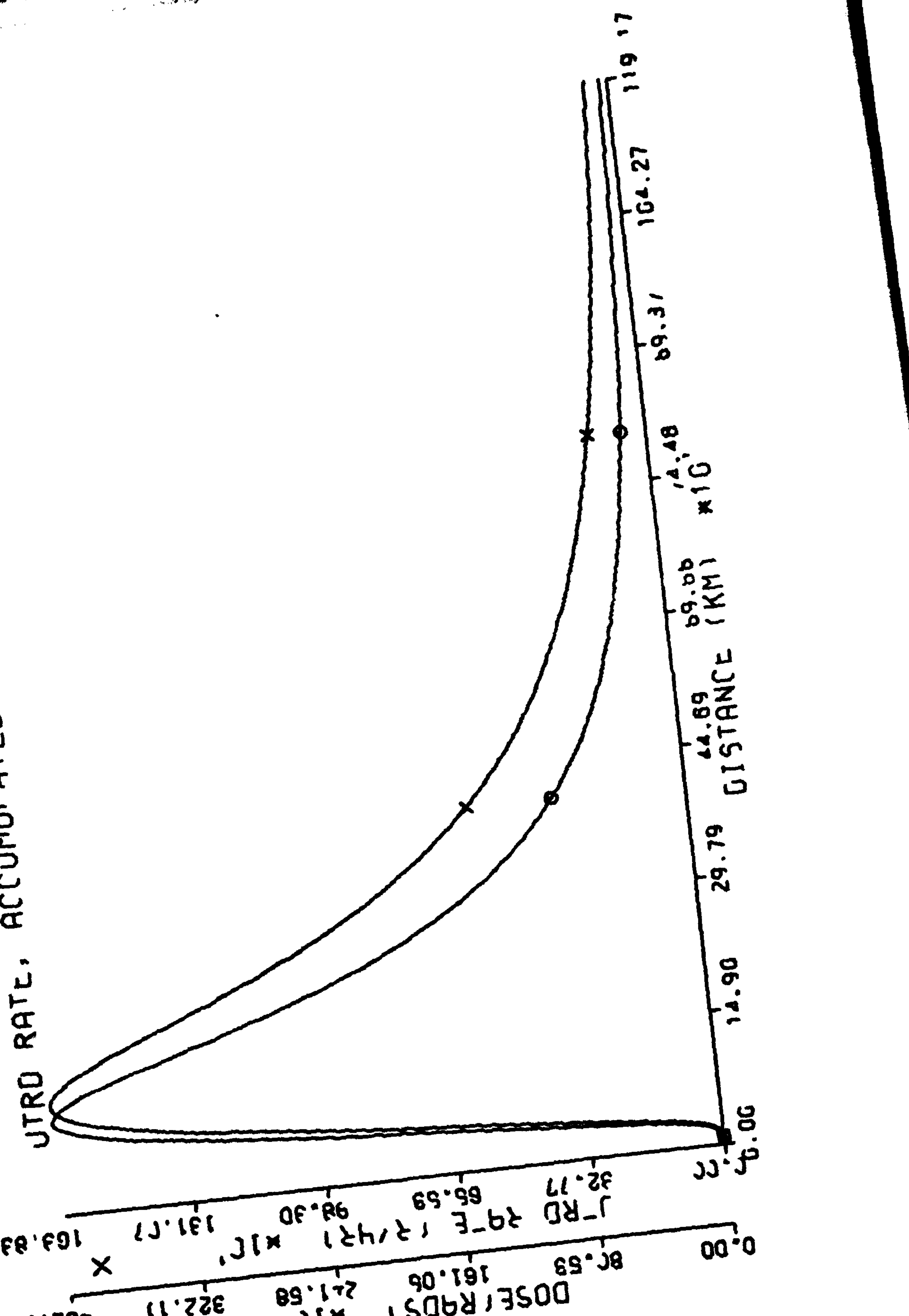
UTRD RATE OF 299.835 RADS/HR OCCUPRED AT 562.50 KM

UTRD RATE OF 99.121 RADS/HR OCCUPRED AT 945.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.08
AT	5.333	HOURS, CUMULATIVE G(T) IS	.24
AT	7.917	HOURS, CUMULATIVE G(T) IS	.36
AT	10.500	HOURS, CUMULATIVE G(T) IS	.46
AT	13.083	HOURS, CUMULATIVE G(T) IS	.54
AT	15.667	HOURS, CUMULATIVE G(T) IS	.60
AT	18.250	HOURS, CUMULATIVE G(T) IS	.65
AT	20.833	HOURS, CUMULATIVE G(T) IS	.69
AT	23.417	HOURS, CUMULATIVE G(T) IS	.72

Fig. E-104.



UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
0.00
14.90
29.79
44.69
59.58
74.48
89.37
104.27
119.17
DISTANCE (KM) x10

Fig. E-105.

YIELD .001 MEGATONS

FISSION FRACTION 1.00

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 1463.0 METERS

3-SIGMA CLOUD THICKNESS 1097.3 METERS

INITIAL HORIZONTAL CLOUD RADIUS .41 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .84142E+00 PER HR, OCCURRED AT .333 HOURS

MAX UTRD RATE, 119.081 RADS/HR, OCCURRED AT 6.25 KM

MAX ACCUM DOSE, 571.966 RADS, OCCURRED AT 6.25 KM

ACCUMULATED DOSE OF 483.761 RADS OCCURRED AT 8.33 KM

ACCUMULATED DOSE OF 95.225 RADS OCCURRED AT 25.00 KM

UTRD RATE OF 93.332 RADS/HR OCCURRED AT 10.42 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.84
AT	5.333	HOURS, CUMULATIVE G(T) IS	.95
AT	8.000	HOURS, CUMULATIVE G(T) IS	.98
AT	10.667	HOURS, CUMULATIVE G(T) IS	.99
AT	13.333	HOURS, CUMULATIVE G(T) IS	.99
AT	16.000	HOURS, CUMULATIVE G(T) IS	1.00
AT	18.667	HOURS, CUMULATIVE G(T) IS	1.00
AT	21.333	HOURS, CUMULATIVE G(T) IS	1.00

Fig. E-106.

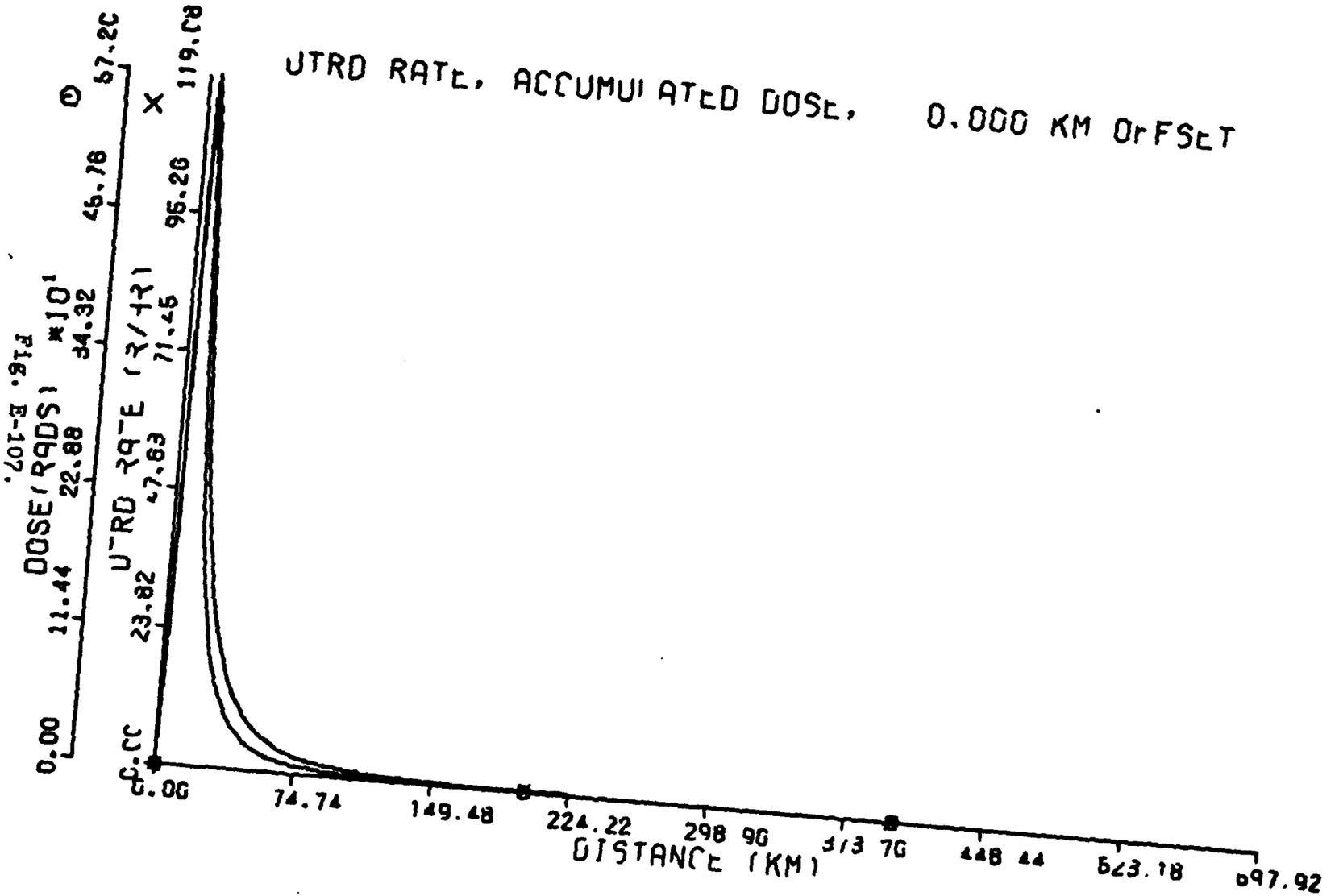

UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10^1
0.00
11.44
22.88
34.32
45.76
57.20
UTRD RATE (R/HR)
0.00
23.82
47.63
71.45
95.28
119.08
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

Fig. E-107

YIELD .010 MEGATONS

FISSION FRACTION 1.00

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 4358.6 METERS

3-SIGMA CLOUD THICKNESS 3269.0 METERS

INITIAL HORIZONTAL CLOUD RADIUS .73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .59

MAX G(T), .29695E+00 PER HR, OCCURRED AT .833 HOURS

MAX UTRD RATE, 221.460 RADS/HR, OCCURRED AT 16.67 KM

MAX ACCUM DOSE, 821.436 RADS, OCCURRED AT 14.58 KM

ACCUMULATED DOSE OF 463.784 RADS OCCURRED AT 31.25 KM

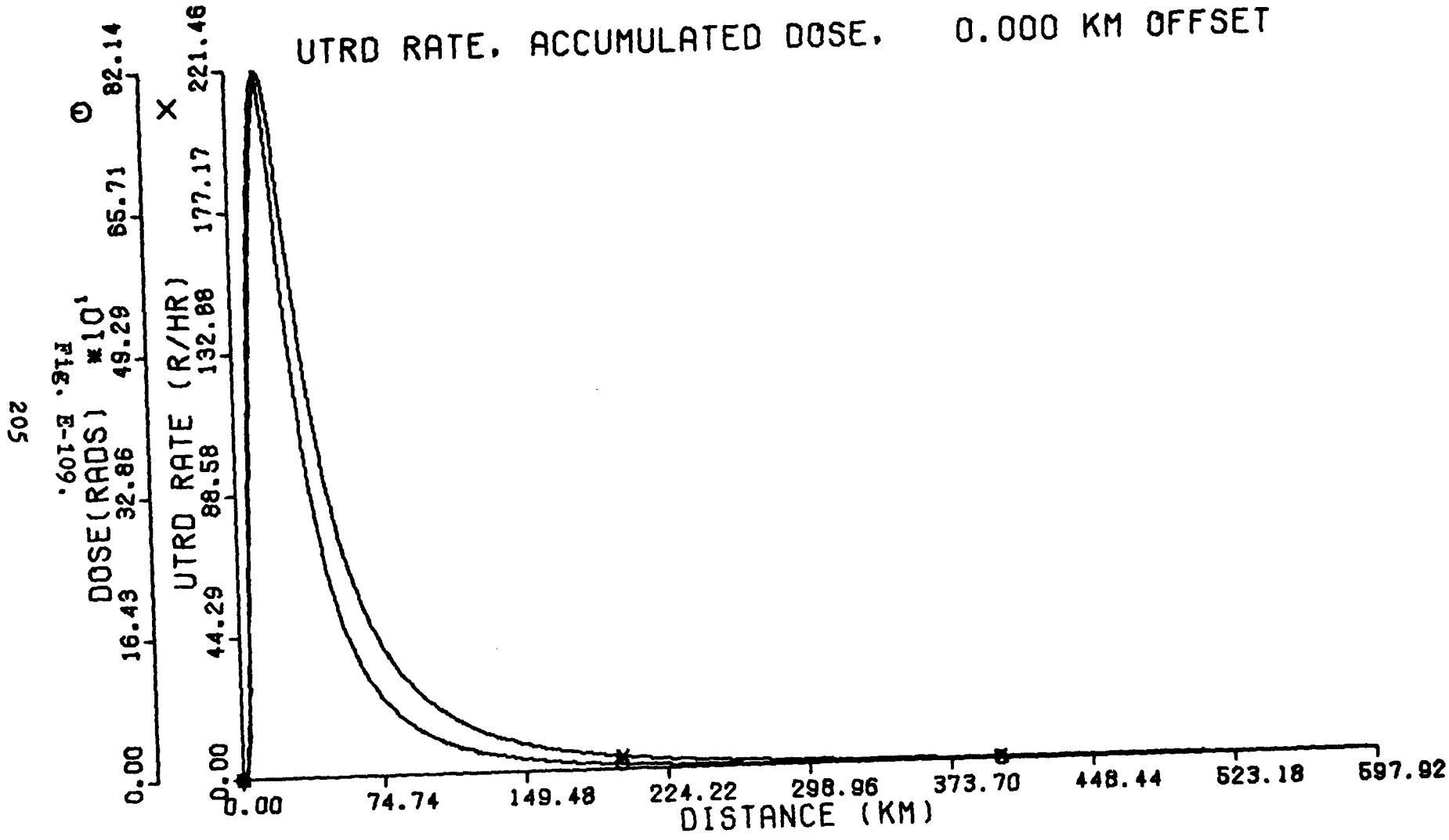
ACCUMULATED DOSE OF 96.999 RADS OCCURRED AT 72.92 KM

UTRD RATE OF 95.569 RADS/HR OCCURRED AT 45.83 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.53
AT	5.333	HOURS, CUMULATIVE G(T) IS	.76
AT	8.000	HOURS, CUMULATIVE G(T) IS	.85
AT	10.667	HOURS, CUMULATIVE G(T) IS	.90
AT	13.333	HOURS, CUMULATIVE G(T) IS	.93
AT	16.000	HOURS, CUMULATIVE G(T) IS	.95
AT	18.667	HOURS, CUMULATIVE G(T) IS	.96
AT	21.333	HOURS, CUMULATIVE G(T) IS	.97

Fig. E-108.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
0.00
16.43
32.86
49.29
65.71
82.14
UTRD RATE (R/HR)
0.00
44.29
88.58
132.88
177.17
221.46
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

205

FIG. E-109.

YIELD .100 MEGATONS

FISSION FRACTION 1.00

INITIAL TIME 0.000 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 9753.6 METERS

3-SIGMA CLOUD THICKNESS 7315.2 METERS

INITIAL HORIZONTAL CLOUD RADIUS 1.78 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .65

MAX G(T), .14371E+00 PER HR, OCCURRED AT 1.667 HOURS

MAX UTRD RATE, 396.647 RADS/HR, OCCURRED AT 31.25 KM

MAX ACCUM DOSE, 1209.756 RADS, OCCURRED AT 27.08 KM

ACCUMULATED DOSE OF 993.377 RADS OCCURRED AT 41.67 KM

ACCUMULATED DOSE OF 493.194 RADS OCCURRED AT 70.83 KM

ACCUMULATED DOSE OF 97.568 RADS OCCURRED AT 152.08 KM

UTRD RATE OF 297.648 RADS/HR OCCURRED AT 54.17 KM

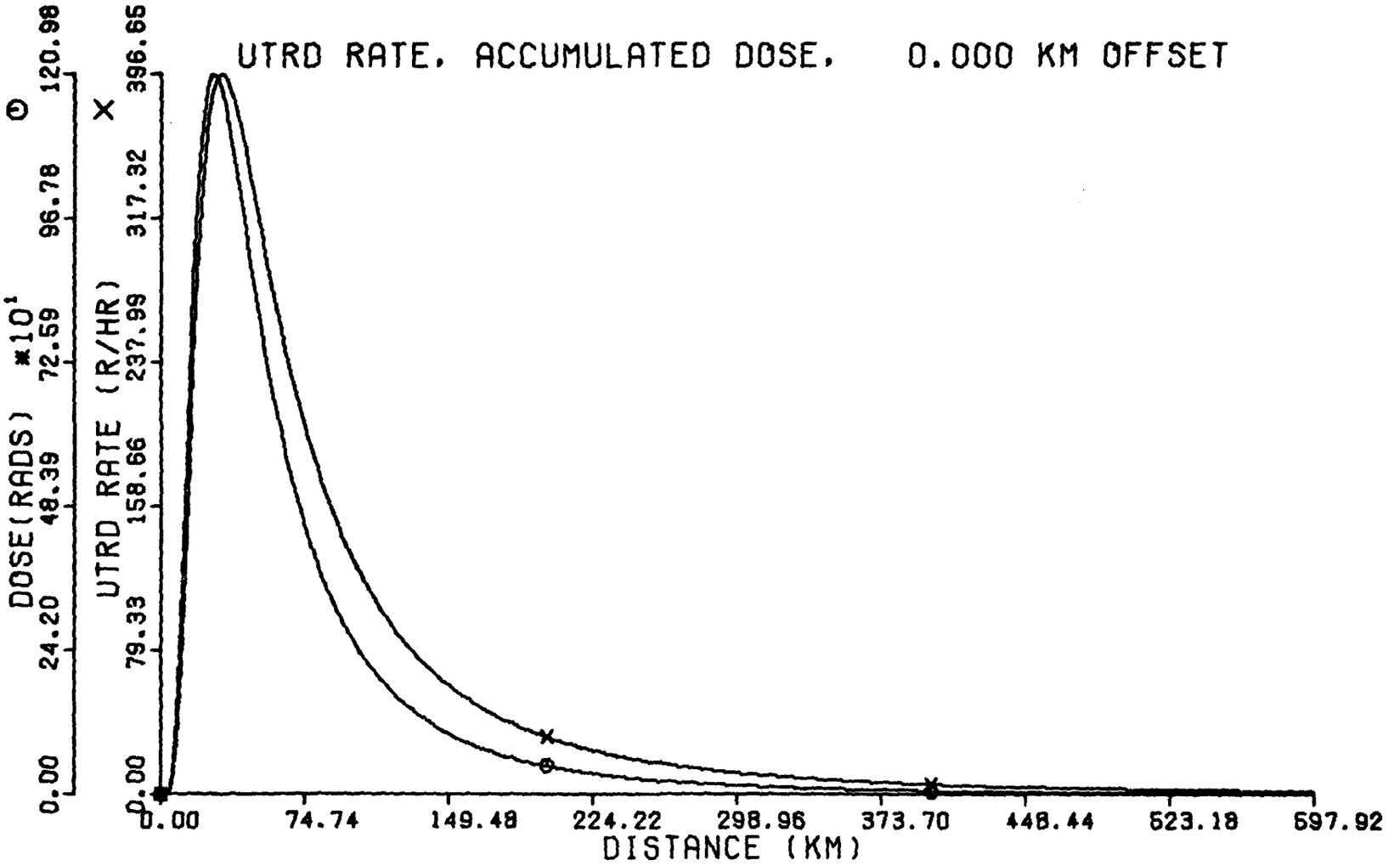
UTRD RATE OF 97.482 RADS/HR OCCURRED AT 116.67 KM

SELECTED CUMULATIVE G(T) DATA

AT	0.000	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.667	HOURS, CUMULATIVE G(T) IS	.27
AT	5.333	HOURS, CUMULATIVE G(T) IS	.52
AT	8.000	HOURS, CUMULATIVE G(T) IS	.66
AT	10.667	HOURS, CUMULATIVE G(T) IS	.75
AT	13.333	HOURS, CUMULATIVE G(T) IS	.80
AT	16.000	HOURS, CUMULATIVE G(T) IS	.84
AT	18.667	HOURS, CUMULATIVE G(T) IS	.87
AT	21.333	HOURS, CUMULATIVE G(T) IS	.90

Fig. E-110.

Fig. E-111.


UTRD RATE, ACCUMULATED DOSE, 0.000 KM OFFSET
DOSE(RADS) *10¹
UTRD RATE (R/HR)
0.00
24.20
48.39
72.59
96.78
120.98
0.00
79.33
158.66
237.99
317.32
396.65
0.00
74.74
149.48
224.22
298.96
373.70
448.44
523.18
597.92
DISTANCE (KM)

YIELD 10.000 MEGATONS

FISSION FRACTION 1.00

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 23652.5 METERS

3-SIGMA CLOUD THICKNESS 17739.4 METERS

INITIAL HORIZONTAL CLOUD RADIUS 5.97 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .70210E-01 PER HR, OCCURRED AT 3.167 HOURS

MAX UTRD RATE, 5335.176 RADS/HR, OCCURRED AT 54.17 KM

MAX ACCUM DOSE, 13591.127 RADS, OCCURRED AT 47.92 KM

ACCUMULATED DOSE OF 997.836 RADS OCCURRED AT 275.00 KM

ACCUMULATED DOSE OF 496.805 RADS OCCURRED AT 358.33 KM

UTRD RATE OF 2994.260 RADS/HR OCCURRED AT 122.92 KM

UTRD RATE OF 991.939 RADS/HR OCCURRED AT 241.67 KM

UTRD RATE OF 297.523 RADS/HR OCCURRED AT 422.92 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.10
AT	5.333	HOURS, CUMULATIVE G(T) IS	.27
AT	7.917	HOURS, CUMULATIVE G(T) IS	.40
AT	10.500	HOURS, CUMULATIVE G(T) IS	.50
AT	13.083	HOURS, CUMULATIVE G(T) IS	.58
AT	15.667	HOURS, CUMULATIVE G(T) IS	.64
AT	18.250	HOURS, CUMULATIVE G(T) IS	.69
AT	20.833	HOURS, CUMULATIVE G(T) IS	.72
AT	23.417	HOURS, CUMULATIVE G(T) IS	.76

Fig. E-112.

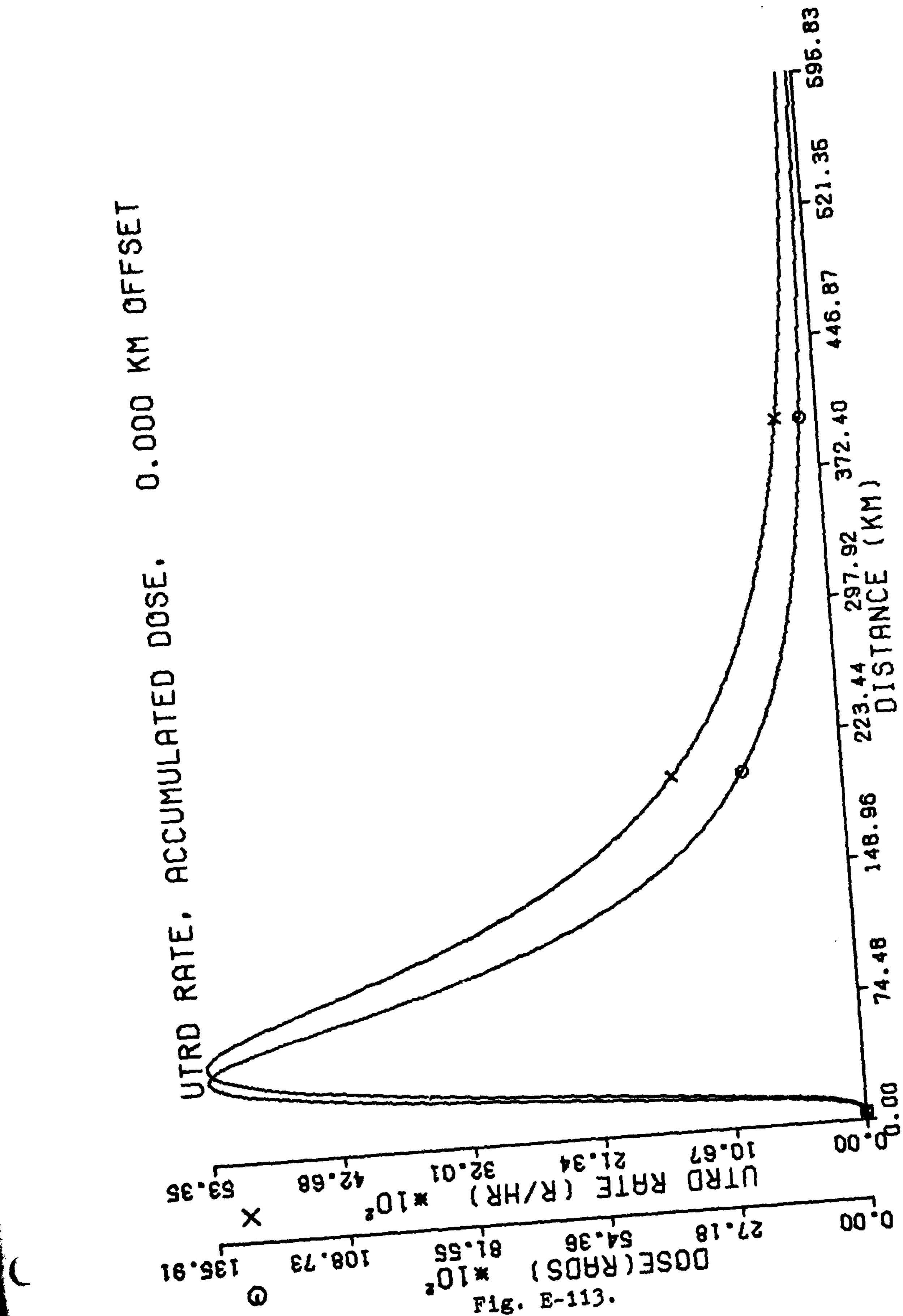

UTRD RATE, ACCUMULATED DOSE.
0.000 KM OFFSET
DISTANCE (KM)
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.36
595.83
UTRD RATE (R/HR) *10²
0.00
10.67
21.34
32.01
42.68
53.35
DOSE(RADS) *10²
0.00
27.18
54.36
81.55
108.73
135.91

Fig. E-113.

YIELD 20.000 MEGATONS

FISSION FRACTION 1.00

INITIAL TIME .167 HOURS

FINAL TIME 24.000 HOURS

CLOUD CENTER HEIGHT 27483.8 METERS

3-SIGMA CLOUD THICKNESS 20612.8 METERS

INITIAL HORIZONTAL CLOUD RADIUS 9.73 KM

Y-OFFSET 0.00 KM

WIND VELOCITY 25.00 KM/HR

WIND SHEAR 1.20 KM/HR PER KM OF CLOUD THICKNESS

A(R) PARAMETERS: MEAN 44.60 MICRONS, SLOPE .69

MAX G(T), .62476E-01 PER HR, OCCURRED AT 3.500 HOURS

MAX UTRD RATE, 6554.331 RADS/HR, OCCURRED AT 50.42 KM

MAX ACCUM DOSE, 16107.759 RADS, OCCURRED AT 52.08 KM

ACCUMULATED DOSE OF 995.599 RADS OCCURRED AT 335.42 KM

ACCUMULATED DOSE OF 499.833 RADS OCCURRED AT 433.33 KM

UTRD RATE OF 2970.108 RADS/HR OCCURRED AT 164.58 KM

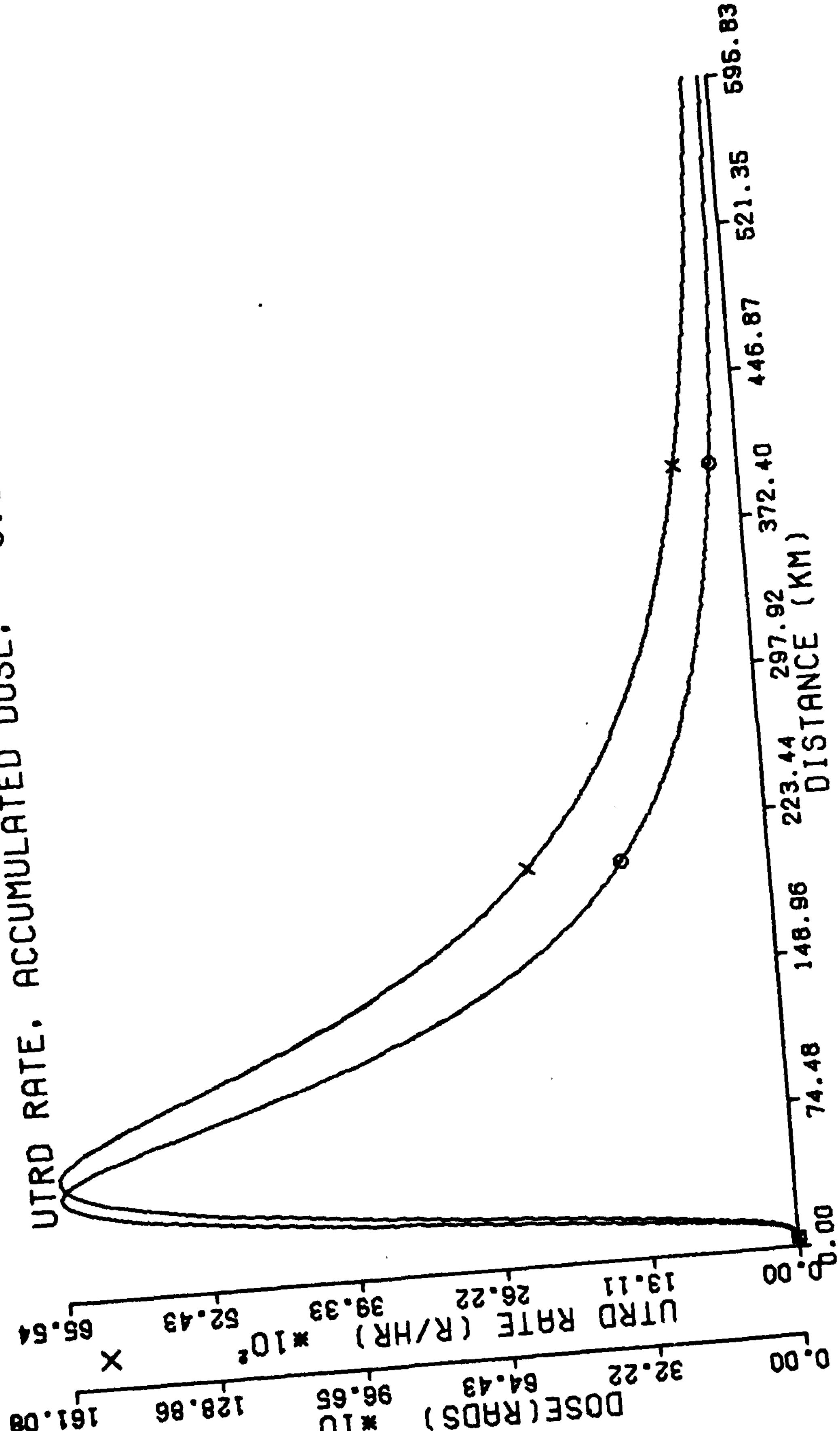
UTRD RATE OF 987.732 RADS/HR OCCURRED AT 310.42 KM

UTRD RATE OF 298.364 RADS/HR OCCURRED AT 533.33 KM

SELECTED CUMULATIVE G(T) DATA

AT	.167	HOURS, CUMULATIVE G(T) IS	0.00
AT	2.750	HOURS, CUMULATIVE G(T) IS	.08
AT	5.333	HOURS, CUMULATIVE G(T) IS	.24
AT	7.917	HOURS, CUMULATIVE G(T) IS	.36
AT	10.500	HOURS, CUMULATIVE G(T) IS	.46
AT	13.083	HOURS, CUMULATIVE G(T) IS	.54
AT	15.667	HOURS, CUMULATIVE G(T) IS	.60
AT	18.250	HOURS, CUMULATIVE G(T) IS	.65
AT	20.833	HOURS, CUMULATIVE G(T) IS	.69
AT	23.417	HOURS, CUMULATIVE G(T) IS	.72

Fig. E-114.



UTRD RATE. ACCUMULATED DOSE. 0.000 KM OFFSET
DISTANCE (KM)
0.00
74.48
148.96
223.44
297.92
372.40
446.87
521.35
595.83
UTRD RATE (R/HR) *10²
0.00
13.11
26.22
39.33
52.43
65.54
DOSE(RADS) *10²
0.00
32.22
64.43
96.65
128.86
161.08

Fig. E-115.

Vita

Richard F. Colarco was born on 9 June 1949 in New York, N.Y. He graduated from Mater Christi H.S. in Astoria, N.Y. in 1966, and attended Manhattan College, where he received the degree of Bachelor of Science (Physics) in May 1970. After graduation he was employed as an electronic countermeasures engineer by the Grumman Aerospace Corporation. He is married to the former Linda Gensinger of College Point, N.Y. He entered the USAF in May 1972, and received his commission from Officer Training School in August 1972. He completed Undergraduate Navigator Training in May 1973 and Electronic Warfare Officer Training in January 1974. From April 1974 to July 1978 he served as a B-52 electronic warfare officer, and electronic warfare trainer supervisor with the 46th Bombardment Squadron and the 319th Bombardment Wing (Heavy), Grand Forks AFB, North Dakota. He entered the Strategic and Tactical Sciences program, School of Engineering, Air Force Institute of Technology, in August 1978.

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Fallout
Nuclear Fallout
Nuclear Weapons Effects

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study describes a method of calculating g(t), the rate of deposition on the ground of radioactivity from the stabilized cloud resulting from a nuclear ground burst. Particle fall dynamics are described by the method of Davies as formalized into a computational algorithm by McDonald. The radius of particle arriving on the ground at any time from a given altitude, and the rate of change of this radius with time are described by polynomials in 1/t. A table of coefficients of these polynomials from

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200 meters to 50 km above sea level is provided. It was found that a pancake (zero-thickness) cloud is an excellent approximation to a vertically-distributed cloud with finite extent. This, and the closed form of the calculation, make for a relatively simple and straightforward algorithm, one in fact that approaches the ease of a hand calculation.